555 N Carancahua Street | Suite 820 | Corpus Christi, TX 78401 | P (361) 883-1668 | F (361) 883-1620
trinityconsultants.com

Trinity Consultants

VIA E-MAIL: Robinson.Jeffery@epa.gov

September 17, 2018

Mr. Jeff Robinson
Air Permits Section Chief
Environmental Protection Agency, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Re: TGTI Response to 112(g) Case-by-Case MACT Determination Questions

Dear Mr. Robinson:

Texas Gulf Terminals Inc. (TGTI) submitted a Case-by-Case Maximum Available Control Technology (MACT) determination in accordance with section 112(g) of the Clean Air ACT (CAA) as part of the TGTI project to obtain a license for the operation of a Deepwater Port (DWP) in Federal waters of the U.S. Gulf of Mexico. On August 27, 2018, TGTI received a letter from the Environmental Protection Agency (EPA) requesting additional information to support the technical review process. The responses that are numbered corresponding to the questions in the August 27, 2018, letter are presented as follows.

1. **Question 1** – Not a "similar source" to sources currently regulated under 40 CFR 63 – Subpart Y
    A. Not structurally similar in design and capacity
        i. MACT Subpart Y offshore loading terminals
            a) Presence of a physical, stable loading berth structure
            b) Proximity to shore, product loading rate, and water depth
        ii. Deepwater Port SPM offshore loading
    B. Cannot be controlled using the same control technology
    C. Comparable emissions
2. **Question 2** – Performance of similar sources for the MACT floor analysis
3. **Question 3** – Similar sources utilizing subsea pipeline for on-shore emissions control
4. **Question 4** – Demonstration of compliance during Maintenance, Startup and Shutdown (MSS)
5. **Question 5** – Compliance monitoring strategy and control efficiency
6. **Question 6** – Best Management Plan for the SPM buoy system

Attachment 1 – LEI Letter, SPM CALM Buoy System, May 2, 2018
Attachment 2 – ABS Letter, ABS Rules for SPMs, May 7, 2018
Attachment 3 – Imodco SPM Installations
Attachment 4 – SOFEC SPM Installations
Attachment 5 – Bluewater SPM Installations

TGTI can meet with EPA to discuss the Case-by-Case MACT determination in more detail to assist with the technical review of the analysis.

EPA Question 1 - Not a "similar source" to sources currently regulated under 40 CFR 63 - Subpart Y

Please provide a detailed technical analysis to support your application statement that the proposed TGTI project and its design is not a "similar source" to those sources currently regulated in 40 CFR 63 - Subpart Y including any details or analysis of the technical differences between your proposed project and those regulated in Subpart Y. See 40 CFR 63.43(e)(1) (incorporating the principles of MACT determinations set forth in 40 CFR 63.43(d)). To establish if a source is similar or not similar, please review the definition of "similar source" as defined in 40 CFR 63.41. In general, a similar source has <u>comparable emissions</u>, structurally <u>similar in design and capacity</u> and <u>could be controlled using the same control technology</u>.

<u>TGTI Response to Question 1:</u>

The proposed SPM buoy system is not a similar source based on structural differences in design and capacity and inability for control using the same control technology when compared to constructed or reconstructed major sources regulated in the National Emission Standards for Marine Tank Vessel Loading Operations (40 CFR 63 - Subpart Y). Per the definition of a similar source in 40 CFR 63.41, the following are key components to determining a similar source with respect to MACT regulations.

1.A. Not structurally similar in design and capacity:

The proposed SPM buoy system will not be similar in design to the sources currently regulated in 40 CFR 63 Subpart Y. The purpose of the proposed SPM buoy system is to enable a very large crude carrier (VLCC) to be fully and directly loaded in an efficient and safe manner. To accomplish this, the SPM buoy system will be located over fourteen miles off shore in waters that are over 90 feet deep. This depth of water is necessary to allow the VLCC to be fully loaded. There are no sources currently regulated by 40 CFR 63 – Subpart Y located fourteen or more miles offshore and in waters of this depth. Further, an SPM buoy system was proposed (as opposed to a pier, platform, or other type of structure) after an in-depth analysis of other potential alternatives was conducted that evaluated the full scope of possible impacts from the proposed operations.

The following sections highlight the differences between the structural design of sources regulated by 40 CFR 63 – Subpart Y (MACT Subpart Y offshore loading terminals) and the proposed Deepwater Port SPM buoy system.

1.A.(i) MACT Subpart Y offshore loading terminals

In the development of the subcategory of offshore loading terminals regulated in 40 CFR 63 – Subpart Y, two sources were considered in establishing the control requirement for new sources. These two sources were identified in a letter from the Bay Area Air Quality Management District (BAAQMD) to the EPA (see Docket ID Number A-90-44-IV-D-80). In the letter, the two sources were identified as follows:

> *"We have two facilities in the Bay Area with loading operations that occur more than 0.5 miles offshore. One is on a platform, and the other is on the end of a very long pier."*

There are important structural distinctions between the sources used to establish the control requirements for new offshore loading terminals regulated under MACT Subpart Y and the proposed SPM buoy system. The structural distinctions include (a) presence of a physical, stable loading berth structure, (b) location – proximity to shore, and (c) product loading rate. Figures 1 through 4 illustrate example loading berth designs that would be regulated as offshore marine loading sources under 40 CFR 63 - Subpart Y.

Figure 1 – Example Pier Design -
MACT Subpart Y Offshore Vessel Loading Source

Figure 2 – Example Pier Design -
MACT Subpart Y Offshore Vessel Loading Source

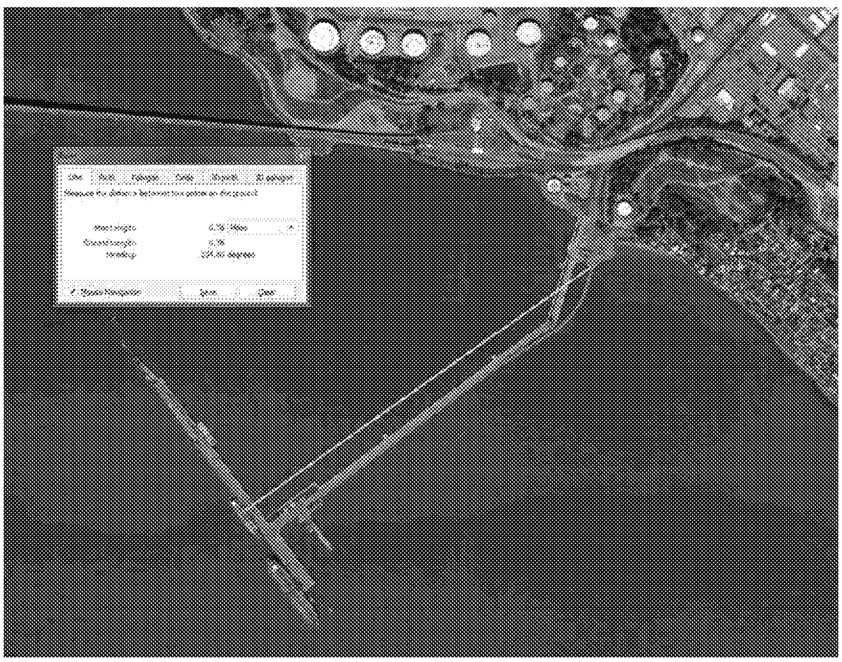
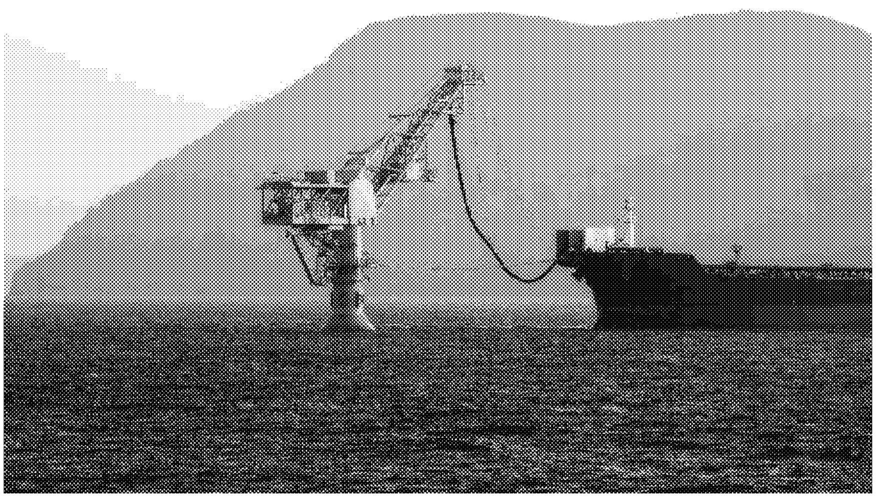


**Figure 3 – Example Platform Design -
MACT Subpart Y Offshore Vessel Loading Sources**

**Figure 4 – Example Platform Design -
MACT Subpart Y Offshore Vessel Loading Sources**



Further discussion of the structural distinctions between new offshore loading terminals regulated under MACT Subpart Y and the proposed SPM buoy system is provided in the following sections.

1.A.(i)(a) Presence of a physical, stable loading berth structure

The presence of a loading berth on the platform and at the end of the long pier provides a key technical difference between these sources and the proposed SPM buoy system such that they cannot be considered similar sources. Unlike the proposed SPM buoy system, these sources are able to control vapors collected by transporting the vapors through piping above water to a control device located relatively close to the vessel being loaded. The inherent design and location of the proposed TGTI SPM buoy system are such that it is not feasible to capture, transport, and control the vapors and associated emissions with the same capture system and control devices required for sources regulated under 40 CFR 63 – Subpart Y.

1.A.(i)(b) Proximity to shore, product loading rate, and water depth

TGTI reviewed the MACT Subpart Y preamble and technological support documents to determine if there were any sources similar to the proposed SPM buoy system that were considered in the rulemaking. Based on this review, TGTI concluded that the offshore loading terminal sources considered in the development of MACT Subpart Y regulations were not similar sources to the proposed TGTI crude export Deepwater Port SPM buoy system (i.e., SPM buoy systems for directly and completely loading a VLCC for crude oil export). No sources loading marine vessels via an SPM buoy system at a distance in excess of 14 miles offshore, at a rate of 60,000 bbl/hr, in water depths of 90 feet or more were considered in the development of MACT Subpart Y. The proposed TGTI SPM buoy system will be a first of its kind for the United States. Export of crude oil was banned in the United States from 1975, following the 1973 OPEC oil embargo, until 2015 to all countries except Canada. As a result, there were no similar sources in operation when MACT Subpart Y was developed in 1995 nor when it was reconsidered in 2011.

1.A.(ii) Deepwater Port SPM offshore loading

Figures 5, 6, and 7 illustrate the SPM-based Deepwater Port offshore loading system design and the extended distance from shore for the proposed TGTI DWP location. As illustrated in Figures 5 and 6, the SPM does not possess key components (e.g., loading arms, pumps, meters) that comprise a loading berth per the MACT Subpart Y definition.

Figure 5 –Deepwater Port SPM Offshore Loading Operation

Figure 6 –Deepwater Port SPM Offshore Loading Operation

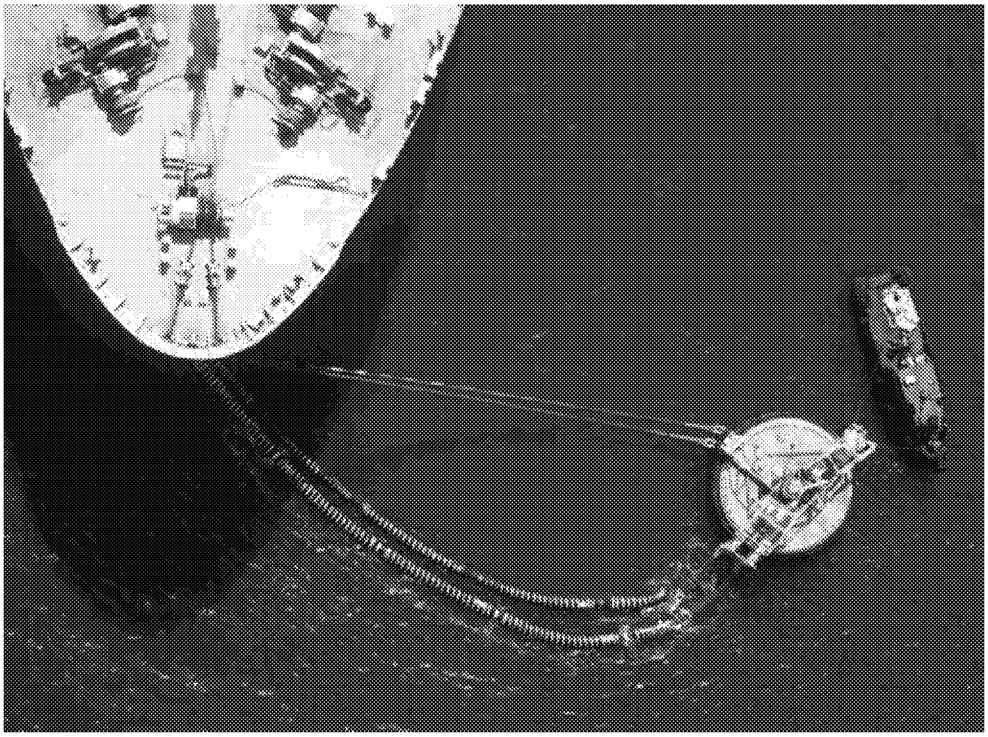
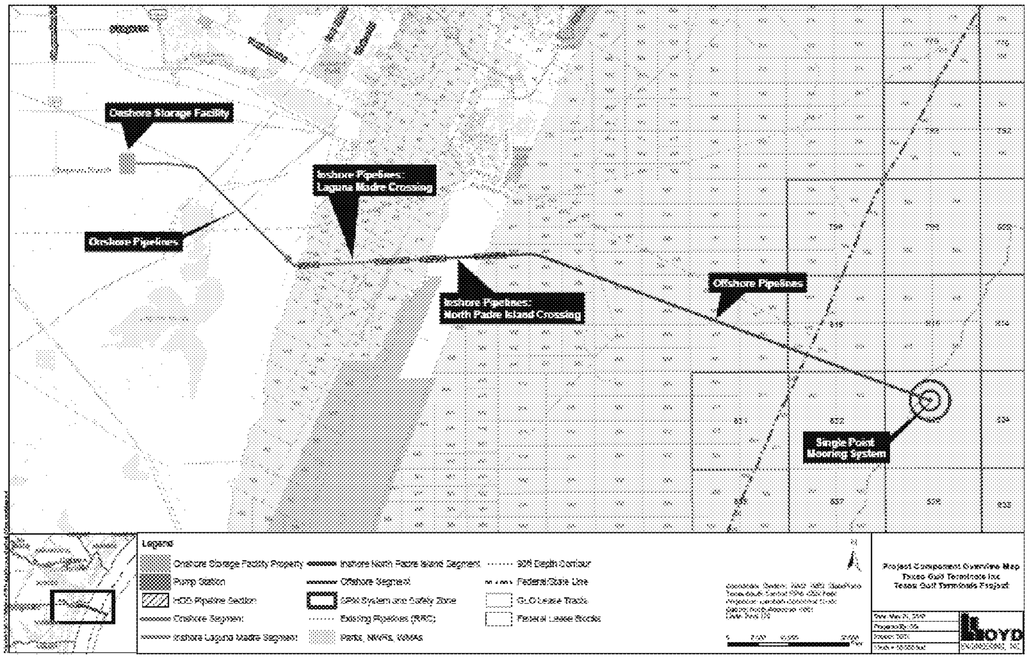


Figure 7 – Proposed TGTI Deepwater Port SPM (14+ miles from shore)



Utilization of a fixed offshore platform would completely change the scope of the proposed project of the SPM buoy system. TGTI conducted an alternatives analysis for the proposed project in compliance with the National Environmental Policy Act (NEPA). The alternatives analysis is one of nine criteria used to determine a final decision under the Deep Water Port Act (DWPA) (33 CFR Subchapter NN Parts 148, 149, and 150). The purpose of the alternatives analysis is to identify and evaluate alternatives to ensure that decisions using the NEPA process regulated under the DWPA are in the best interest of the U.S., and consistent with national security, energy policies, and environmental policies. Specifically, the environmental objectives of the project are defined as follows:

- Minimizes impacts to waters of the U.S. (WOUS), including wetlands, and special aquatic resources;
- Minimizes impacts to threatened and endangered (T&E) species and their associated habitats;
- Minimizes impacts to cultural resources;
- Minimizes impacts to navigation and navigation safety;
- Minimizes impacts to commercial and recreational fisheries and essential fish habitats (EFH);
- Existing land use compatibility, availability, and suitable for the proposed project;
- Project location within the proximity of existing and planned crude oil infrastructure, thereby reducing project footprint and environmental impacts;
- Project design that allows for the maximization of offsite fabrication in a controlled setting thereby minimizing the offshore impact as a result of the onsite construction activities.

The proposed SPM buoy project accomplishes each of the goals above better than any of the alternatives. Specifically, when compared to a fixed platform, the SPM buoy system is superior for the following reasons:

- The proposed SPM buoy system minimizes the potential for interference with natural processes
    - The SPM buoy system design allows for moored vessels to accommodate for existing natural processes such as wind, waves, and currents, which exhort forces on and below the water surface. The smaller footprint of the SPM compared to a fixed platform, both above and below the surface of the water, results in minimal interference with forces exhorted by natural processes.
    - The proposed SPM buoy system would be supported in location by tension chains designed to allow for movement with natural forces. A ridged fixed platform would require the installation of multiple rigid pile structures both above and below the surface of the water.

- Availability of Safe Loading
    - The mooring of vessels to the proposed SPM buoy system would not be sensitive to directional changes of wind, waves, and currents since the vessel would be free to "weather-vane" around the buoy to stay head-on to forces during weather, wind, wave, and current forces. Weather-vaning is the ability for VLCC's to have a complete 360° radius to move around the SPM buoy system without interrupting the loading process. A fixed dock would be sensitive to changes such that changes in sea and weather conditions could affect the ability to safely load the VLCC.

- Personnel Required for Operation
    - The proposed SPM buoy system will be "un-manned" in the sense that the only operation required from personnel other than personnel on the VLCC will only be what is required for the tug boats that assist during mooring and unmooring of the VLCC from the SPM buoy system and product hose connection and disconnection. A fixed offshore platform requires more involvement from support vessels and personnel on the platform. Therefore the operation of a fixed platform is more complex than the operation of the proposed SPM buoy system. The increased complexity increases the potential for health and safety exposures compared to the proposed SPM buoy system.

- Footprint
    - The proposed SPM buoy system will be approximately 1,000 ft2 and approximately 25 ft in height. For comparison, a fixed platform would have to be approximately 25,000 ft2 with mooring dolphins, catwalks connection each structure, and a helipad. If a vapor recovery unit (VRU) and/or a vapor combustion unit (VCU) were required, it would increase the physical size of the platform even more. It would also require utility support (i.e., electrical generator) with a fuel source for continuous operation, operating personnel, and condensate storage tanks. The footprint of a fixed platform would be further

increased by the need for a positive displacement blower and interlocks (pressure gauges, valves, etc) that would be needed to counteract the static pressure losses encountered in the condensate vent piping between the VLCC and the vapor control device.

The proposed SPM buoy system was selected after careful consideration of many alternatives and determined to be the best option for the objective of the project, to fully and directly load a VLCC in a safe and effective manner that provides a logistical solution for the safe, efficient, and cost-effective export of crude oil to support U.S. economic growth. The reasons outlined justify the selection of an SPM buoy system instead of a fixed platform. Further, it is concluded that a fixed offshore platform represents a significant deviation from the project design/scope of the proposed SPM buoy system.

As evidenced by Figures 5, 6, and 7 and as discussed in the prior sections, the proposed TGTI DWP is structurally distinct in design and capacity from sources regulated under MACT Subpart Y due to (a) the fact that it does not have a physical, stable loading berth structure (neither a pier nor fixed platform), (b) it will be located approximately 15 miles offshore, and (c) its design loading rate is significantly greater than the MACT Subpart Y offshore loading terminal source.

1.B. Cannot be controlled using the same control technology

TGTI is proposing to control HAP emissions from the proposed SPM buoy system with the utilization of submerged loading and a VOC management plan, as detailed in the case-by-case application. The design differences between the proposed SPM buoy system and the sources currently regulated under 40 CFR 63 – Subpart Y present technical challenges that make the control of the proposed SPM buoy system with vapor collection and abatement systems employed on MACT Subpart Y regulated sources technically infeasible. The discharge of HAP emissions from the loading of vessels when offshore and subject to harsh sea conditions (waves, ocean currents, etc) is significantly different than the discharge of vapors that occurs from a vessel at a MACT Subpart Y regulated source. The inherent differences present unique engineering and operational challenges for capturing, transporting, and controlling VOC emissions generated from the loading of a marine vessel that is miles offshore.

To control the vapor from the proposed SPM buoy system using the same control technology used on current sources, vapors would have to be routed back to shore using an additional subsea line. As mentioned later in this letter in TGTI's response to Question 3, there are no existing sources that utilize an additional subsea line in this manner. Significant technical challenges to this approach contribute to its lack of demonstration in practice.

- Venting of crude loading vapors through an underwater pipe to a land-based abatement system (VRU/VCU) is not technologically feasible for control of VOC emissions due to the unproven application offshore at the stated distance.
  - The proposed SPM has an inherently small footprint (1,000 ft^2) that cannot accommodate equipment to create the pressures necessary to transport the vapors roughly 15 miles back to shore. It is also important to note that not only will there be friction losses across the 15 miles back to shore, but there will also be static pressure losses associated with the 90 ft of elevation gain back to sea level.

- Vapor condensation in the vapor subsea line would lead to safety concerns. The vapor/liquid interface generated by the condensed vapors would be a source of static electricity and thus, an explosion hazard.
    - At onshore systems, this condensate does not inhibit the operation of VOC control devices because there are design options available to mitigate the effects of condensation such as a knock out drums, inclined lines, and drainage to traps. This would not be possible for a subsea pipeline carrying vapors back to shore. There would be no opportunity to set up drains or condensate knock out drums until the pipeline reached shore (roughly 15 miles away) and the low point of the line (where condensate will collect) will be directly below the SPM buoy system because the SPM will be located in deep waters.

- Required flash-back devices (per Coast Guard regulations) could not be located in the required positions.
    - Flash back devices (flame arrestors) must be placed in vertical pipe sections to prevent flame from propagating thru condensate on the pipe bottom draining thru the device. At the location of the SPM buoy system, flash back devices could not be serviced at ocean depth if fouled.
    - U.S. Coast Guard design and installation regulations for marine vapor control systems (VCS) at facilities transferring oil or hazardous material in bulk (33 CFR 154.2105) require a detonation arrester to be located within 18 meters (59.1 feet) of the facility vapor connection. The distance requirements for the flame arrestor are easily met at fixed berths because the vessel is moored directly against the fixed dock. However, with the proposed SPM buoy system, the inherent space limitations prohibit a flame arrestor from being located close enough to the vapor collection system connection to be in compliance with the Coast Guard regulations.

1.C. Comparable emissions

Emissions from the proposed deepwater port SPM buoy system are comparable to emissions from sources currently regulated by 40 CFR 63 – Subpart Y. Emissions from marine vessel tank loading are generated from the release of vapors contained in the head space of marine vessel tanks as they are being filled with liquid. Vapor from the head space of the tanks is released in order to maintain safe operating pressures inside the marine vessel tank. The released vapor is a combination of inert gas for blanketing, residual vapor from the tank's previous cargo, and vapor from the volatilization of the crude/condensate being loaded. Several factors influence the formation of hazardous air pollutant (HAP) vapors in the head space of the tanks including the vapor pressure of the product being loaded, the vapor HAP weight percent, and the surface area of the product that is exposed to air. The liquid product vapor pressure is an inherent property of the cargo but work practice standards such as submerged loading are utilized to mitigate turbulence on the surface of the liquid and thus minimize the exposed surface area. Emissions from the SPM buoy system therefore, are comparable to the sources currently regulated under 40 CFR 63 – Subpart Y.

In summary, although potential emissions from the proposed SPM buoy system are comparable to the emissions from sources that are currently regulated under 40 CFR 63 Subpart Y, the proposed SPM buoy system is not a similar source due to structural differences in design and the infeasibility for control with the same control technologies required for 40 CFR 63 Subpart Y sources. As such, HAP emissions control for the proposed Deepwater Port SPM buoy system requires evaluation under a 112(g) case-by-case MACT determination.

EPA Question 2 - Performance of similar sources for the MACT floor analysis

Additional information is needed to evaluate the performance of similar sources for the MACT floor analysis. Single Point Mooring (SPM) systems are not considered a new design and have been in use for various marine loading operations. It is important to first understand the current use of SPMs based on their design and capacity. Please provide reviewed references and supporting contacts/vendors used to identify current SPM operations. Based on the database searches or vendor data, please identify existing operations that utilize SPMs for marine loading. From the identified list of SPMs, do any of the SPM's utilize a method of Vapor Emissions Control (VEC)? If so, please provide a supporting analysis that would technically illustrate whether the control would, or would not, be feasible for the for the proposed TGTI operation based on volumetric loading differences or other operational parameters that might exist. Are there any SPMs operating in water depths greater than 90 feet, and if so, please describe any operational and/or air pollution control equipment to reduce Hazardous Air Pollutant (HAP) and/or Volatile Organic Compound (VOC) emissions? Also, please provide any other additional analysis you may have to supplement your application that discusses why sources using some form of VEC while loading crude tankers offshore either are or are not considered similar sources to the project proposed by TGTI.

<u>TGTI Response to Question 2:</u>

Based on TGTI's research and review of qualifications for the three primary SPM manufacturers (Imodco, SOFEC, and Bluewater), over 560 SPMs are utilized throughout the world. Figure 8 illustrates the SPM global footprint.

On TGTI's behalf, Lloyd Engineering contacted the three major SPM vendors to inquire if any SPM buoy systems have been installed with vapor controls. All three vendors confirmed to the best of their knowledge no SPM buoy systems utilize vapor controls. A letter from Lloyd Engineering denoting the results of its inquiry with the three SPM venders is included as Attachment 1. Lloyd Engineering also contacted American Bureau of Shipping (ABS) to determine whether ABS Rules for building and classifying SPM systems contain requirements or provisions for vapor control systems on SPMs. ABS is a Recognized Organization (RO) or Recognized Security Organization (RSO) with the authority to issue certificates in accordance with various international and national maritime conventions and codes. ABS Rules & Guides are derived from principles of naval architecture, marine engineering and related disciplines. ABS responded that its SPM rules do not include requirements for vapor control systems and that none of the SPMs that they have recently classed have been fitted with vapor control systems (see letter dated May 7, 2018, in Attachment 2). This supports the determination presented in the case-by-case MACT permit application submitted in July 2018 that no SPM buoy systems currently in operation (whether they operate in water depths greater than 90 feet or not) utilize a method of VEC beyond the use of submerged loading and best management practices.

Figure 8 – SPM Global Footprint

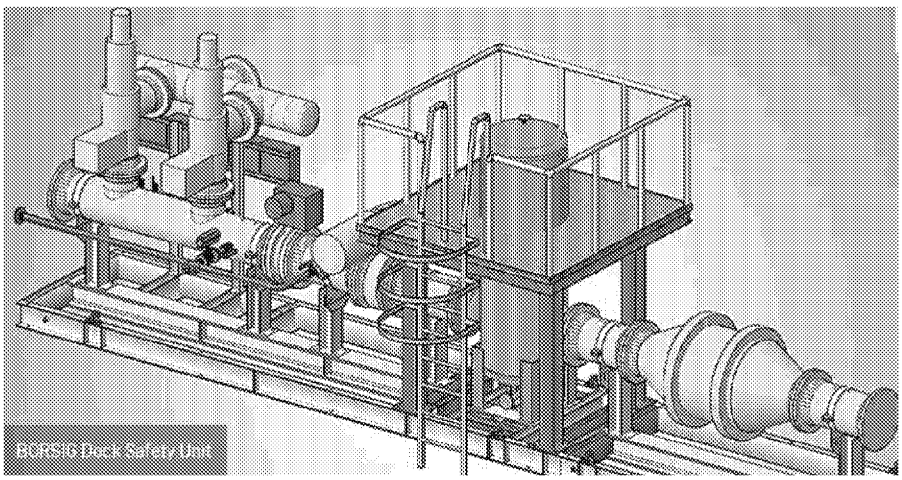
EPA Question 3 - Similar sources utilizing subsea pipeline for on-shore emissions control

As discussed above, the utilization of control technologies identified from available information is an important principle of MACT determinations. As such, are there any known similar sources capturing and utilizing an additional subsea pipeline to route marine loading vapors back on-shore to an emissions control device? Are there any other regulatory or safety requirements (e.g., U.S. Coast Guard) that might prevent this type of potential control? If such a similar source exists, please remember to include any consideration for the costs and any associated non-air quality health and environmental impacts and energy requirements that might impact TGTI if such an option was considered for HAP control.

TGTI Response to Question 3:

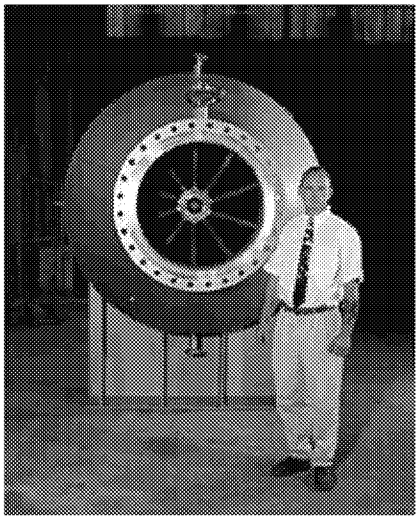
As discussed in the response to Question 2, no similar sources capture and utilize an additional subsea pipeline to route marine loading vapors through an SPM buoy back on-shore to an emissions control device based on TGTI's research. Furthermore, U.S. Coast Guard design and installation regulations for marine vapor control systems (VCS) at facilities transferring oil or hazardous material in bulk (33 CFR 154.2105) require a detonation arrester to be located within 18 meters (59.1 feet) of the facility vapor connection. A detonation or flame arrester is a device that prevents potentially explosive mixtures from igniting, stops the propagation of a flame, or limits the spread of an explosive event. Flame arresters are large devices that can weigh multiple tons. Figure 9 depicts an example skid mounted Dock Safety Unit. Figure 10 depicts a very large (10 ton) flame arrester designed for a 30 inch pipe.

Figure 9 – Dock Safety Unit Schematic[1]



[1] https://www.borsig.de/en/products-and-services/emission-control/dock-safety-unit/

Figure 10 – Large Flame Arrester[2]



The closest feasible location for a detonation arrester to be located on a return vapor line would be after the vapor is routed back through the SPM. This distance would be significantly greater than the 18 meters required in 33 CFR 154.2105 and it could not be met with a return vapor line routing the collected vapors from the VLCC through the SPM and then through a subsea pipeline back to shore.

EPA Question 4 - Demonstration of compliance during Maintenance, Startup and Shutdown (MSS)

Please provide additional information to support the proposed method(s) for a continuous demonstration of compliance during Maintenance, Startup and Shutdown (MSS). The permit application does not appear to include emission calculations for MSS emissions (e.g., pigging, hydrostatic pressure tests on the SPM and hoses, or inspection/replacement of hoses) for marine loading. This demonstration may include best management practices and/or schedules for MSS.

TGTI Response to Question 4:

MSS activities that occur at the SPM buoy system are inherently different than MSS activities typically performed for on-shore pipelines and terminals. Specific considerations to avoid marine water pollution also avoid the generation of MSS activity air emissions at the SPM buoy system. Multiple mitigation techniques are incorporated into the overall design of the system including its closed loop design, breakaway couplings, and safety controls.

To ensure the marine environment is not polluted, the pipeline system will be flushed out with water from shore prior to the beginning of any maintenance activities. To accomplish this, a piece of pipe that is shaped like a "U" is used to connect the two hoses at the SPM buoy system together. This creates a closed loop with the onshore facility. Water is then used to flush the pipeline and hoses before maintenance activities commence. As a result, emissions are not generated from maintenance activities for SPM components that handle product (pipeline, hoses, etc.). All pigging operations will be performed in a closed loop system that originates, ends, and are accounted for at TGTI's on-shore facilities.

[2] https://wikivisually.com/wiki/Detonation_flame_arrester

The hoses that connect the SPM to the VLCC manifold are equipped with flanges that close butterfly valves in the hose system when loading is complete. This assures the liquid product is retained in the loading hose or directed to the enclosed tank system on board the VLCC. Furthermore, breakaway couplings are employed that join segments of the floating hose together. By design these couplings immediately seal shut the ends of the hose by valves if necessary.

Hydrostatic pressure tests are performed during the initial commissioning and after a major repair to the SPM buoy system. These tests will be performed with water supplied from the on-shore terminal and will be a closed-loop process that avoids generation of emissions to the atmosphere.

Inspection of hoses does not require opening the system to the atmosphere. The hoses incorporate a double carcass system. The primary carcass is surrounded by the secondary carcass and both carcasses are independently secured to integral hose end fittings. The two carcasses function independently of each other and during normal operation the secondary carcass does not fatigue. Therefore if the primary carcass fails, the secondary carcass is capable of containing the leak from the primary carcass. The leak detection system on the hose is based on a visual inspection through a transparent window near the flexible hose couplings. Under normal circumstances, the site glass will be empty, indicating the integrity of the primary carcass is not compromised. If the site glass shows fluid, then the primary carcass has been compromised and the hoses will be replaced.

EPA Question 5 - Compliance monitoring strategy and control efficiency

The 112(g) application does not provide a compliance monitoring strategy for the marine loading operation or estimated control efficiency of the work practice standard. EPA requests that TGTI propose a monitoring, recordkeeping and reporting strategy to ensure enforceability of the proposed MACT work practice standard and an estimated control efficiency expected to be achieved with this work practice standard in accordance with section 112(h) of the CAA.

<u>TGTI Response to Question 5:</u>

TGTI proposed BACT as submerged loading into vessels which have a VOC Management Plan as required by Regulation 15.6 of MARPOL, Annex VI and adopted in Marine Environment Protection Committee (MEPC) Resolution MEPC.185(59). The VOC Management Plan is a ship-specific management plan that is carried on-board the tanks being loaded. TGTI proposes the following for monitoring, recordkeeping, and reporting:

1. Monitoring
    a. TGTI will monitor the loading rate of the VLCC to ensure the maximum flow rate does not exceed 60,000 bbl/hr.
        i. TGTI will be in constant communication with the crew on the vessel during the loading process and will adjust the loading flowrate as necessary to enable the vessel to adhere to its VOC Management Plan.
        ii. 60,000 bbl/hr is the maximum allowable flow rate for the proposed SPM buoy system but does not necessarily correspond to the maximum loading rate of a particular VLCC.[3] TGTI will not exceed 60,000 bbl/hr or the maximum allowable loading rate of the VLCC being loaded, whichever is lower.

[3] The maximum loading rate for VLCCs can be significantly higher than 60,000 bbl/hr.

   b. TGTI will monitor the annual volume of product loading to ensure the maximum annual product volume loaded does not exceed 192 million bbl/yr.
2. Recordkeeping
   a. TGTI will request and keep a copy of the VOC Management Plan for each VLCC that is loaded from the proposed SPM buoy system.
   b. TGTI will record the loading rate of the VLCC continuously.
   c. TGTI will confirm and document that the VLCC is being loaded via submerged loading.
3. Reporting
   a. TGTI will submit annual reports that certify the above monitoring and recordkeeping requirements.

A HAP and VOC emission control efficiency of 60% is expected to be achieved with this work practice standard as represented in the NSR Permit Application submitted for the TGTI DWP License application.[4]

EPA Question 6 – Best Management Plan for the SPM buoy system

To provide continued compliance demonstration with the fugitive HAP emissions associated with the SPM buoy system, VOC management plans have been used to serve as an indicator of HAP emissions. The 112(g) application relies on a VOC Management Plan this is developed and maintained by the Very Large Crude Carrier (VLCC) and not TGTI. This VOC Management Plan is an important consideration and should be considered. However, TGTI should develop a Best Management Plan for the SPM buoy system that includes effective plan for ship/shore interface, cargo transfer operations (i.e., minimizing gas formation in cargo tanks), maintenance (i.e., pigging), environmental (i.e., Leak Detection and Repair [LDAR] program), safety and health considerations and emergency preparedness.

<u>TGTI Response to Question 6:</u>

TGTI will ensure that each VLCC loaded at the SPM buoy system has a VOC Management Plan that meets the requirements of MEPC.185(59) and that submerged loading is always utilized. As noted in the response to Question 5, TGTI will ensure the loading rate does not exceed the maximum loading rate of 60,000 barrels per hour or the maximum loading rate of the VLCC being loaded, whichever is lower. TGTI will maintain constant communication with the crew aboard the VLCC during the loading process and will adjust the loading rate as necessary during loading to ensure vessel tank conditions are managed according to the VLCC's VOC Management Plan for the minimization of VOC emissions during loading. Data acquisition, transmission, and processing equipment will be installed on the SPM buoy system. A telemetry system will be utilized to transmit information to the onshore control room and mooring master on the VLCC. The telemetry system will be designed to meet the following functional requirements:

- Product pressure monitoring
- Hawser load monitoring
- Navigation aids control and monitoring
- Power system monitoring
- Radio system monitoring and transmission diagnostic data
- Real time data display

[4] Reduction in emissions generated from submerged loading compared to splash loading (75 FR 65115, Oct. 21, 2010), July 2018, TGTI New Source Review Air Permit Application, page 7-13, Table 7-1.

Buoy telemetry and navigation aids will be powered by a solar and/or wind powered system comprised of a battery bank, solar panels, solar charge controller, and/or wind powered system.

As discussed in the response to Question 4, prior to MSS activities on the SPM buoy system, the pipeline will be flushed with water to remove residual product. This is inherently different than how MSS is performed on liquid product pipelines and terminals that are located on-shore. As such, typical MSS activities will not generate air emissions at the SPM buoy system.

The potential VOC and HAP emission rates for fugitive components on the SPM buoy system are 0.22 tpy and 0.004 tpy, respectively. The SPM equipment layout is designed to minimize pipe run lengths and associated connectors, this inherently minimizes potential emissions. Texas Commission on Environmental Quality (TCEQ) BACT requirements for equipment leak fugitives do not a require Leak Detection and Repair (LDAR) program when a facility is designed such that the potential to emit from piping component equipment leak fugitives is less than 10 tpy for VOC.[5] As a result, BACT for fugitive component equipment leaks for the proposed SPM buoy system is minimization of fugitive emissions through equipment layout and design

TGTI appreciates EPA's timely technical review of the permit application. If it would assist in the technical review process, TGTI is willing to meet to discuss in more detail the proposed compliance monitoring strategy and BACT considerations. If you have any questions, comments, or need additional information, do not hesitate to contact Denise Rogers at (832) 203-6493 or me at (972) 661-8100.

Sincerely,

TRINITY CONSULTANTS

Brian Burdorf

Brian Burdorf
Director

cc: Denise Rogers, Compliance Manager - TGTI

[5] https://www.tceq.texas.gov/assets/public/permitting/air/Guidance/NewSourceReview/bact/bact_fugitives.pdf

ATTACHMENT 1 - LEI LETTER, SPM CALM BUOY SYSTEM, MAY 2, 2018

LLOYD
ENGINEERING, INC.

May 2, 2018

Texas Gulf Terminals Inc.
5 Houston Center
1401 McKinney, Suite 1500
Houston, Texas 77010
Attn: Ms. Denise Rogers

Subject: Texas Gulf Terminals Inc. Project
Proposed Single Point Mooring (SPM) CALM Buoy System

Dear Ms. Rogers:

This is to confirm that Lloyd Engineering, Inc. (LEI) is familiar with and has worked with the major vendors that provide final design, procurement, construction, and installation of SPM CALM buoy systems worldwide. The three major vendors are as follows:

1) IMODCO
2) SOFEC
3) Blue Water

We contacted all of these vendors to inquire if they have designed and installed any SPM's that have vapor controls for the air emissions from the vessel that is being loaded. The individuals contacted have confirmed, to the best of their knowledge, that their companies have not provided any SPM systems that utilize vapor controls.

Please feel free to contact me if you have any further questions concerning this letter.

Sincerely,

Lloyd Engineering, Inc.
TXBPE #4826

Stan Lloyd

J.S. Lloyd, P.E.
President

Copy: Matthew Lloyd, V.P.; Director of International Operations

ATTACHMENT 2 - ABS LETTER, ABS RULES FOR SPMS, MAY 7, 2018

Date: Monday, 07 May 2018

Lloyd Engineering, Inc.
6565 West Loop South, Suite 708
Houston, TX 77401

Attention: Stan Lloyd – President

Subject: ABS Rules for Building and Classing Single Point Moorings – 2014 (updated March 2018)

Dear Sir,

Relative to your email dated 6 May 2018 inquiring whether ABS Rules for Building and Classing Single Point Moorings contain requirements or provisions for vapor control systems on SPM's, please be advised as follows:

The ABS SPM Rules contain requirements for fluid transfer systems on Single Point Moorings. The fluid transfer system includes the pipeline end manifold (PLEM), riser, product swivels and floating hoses. These Rules do not include requirements for vapor control systems.

We have also checked our records of Single Point Moorings recently classed by ABS and have verified that none have been fitted with vapor control systems

If you have any questions, please do not hesitate to contact the undersigned.

Regards,

for C. [signature]

Bret Montaruli
Vice President and Chief Engineer

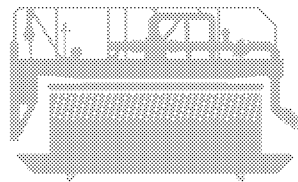
ABS Plaza, 16855 Northchase Drive | Houston, TX 77060 USA
TEL: 1-281-877-6000 | FAX: 1-281-877-5976 | Email: ABS-WorldHQ@eagle.org | www.eagle.org

CALM Terminals
Track Records

Imodco
Building upon SBM Offshore Terminals Technology

Imodco at a glance

Imodco is the leading supplier of CALM buoys, with over 450 systems designed and installed worldwide since 1958. We are a dedicated CALM Engineering, Procurement, Construction and Installation contractor. We provide reliable and safe systems to the highest HSSE and quality standards while also ensuring aftersales support during the asset's lifetime.



1958
1st CALM Buoy

Building upon SBM Offshore terminals technology, Imodco has optimized and qualified the CALM buoy design to remain in the water for up to 30 years before dry dock is required, allowing for major cost savings for clients.

Imodco terminals enable bulk liquid carriers to perform cargo loading, un-loading, bunkering and de-ballasting operations simultaneously. We offer customizable turntable Wheel & Rail or Main Roller Bearing designs, both optimizing safe, operations as well as maintenance activities.

~60 years
of experience

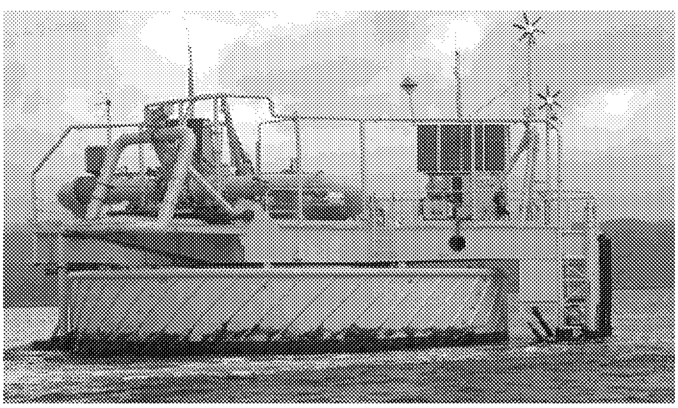
450 Mooring systems Delivered

~60 countries
serviced by our After-sales

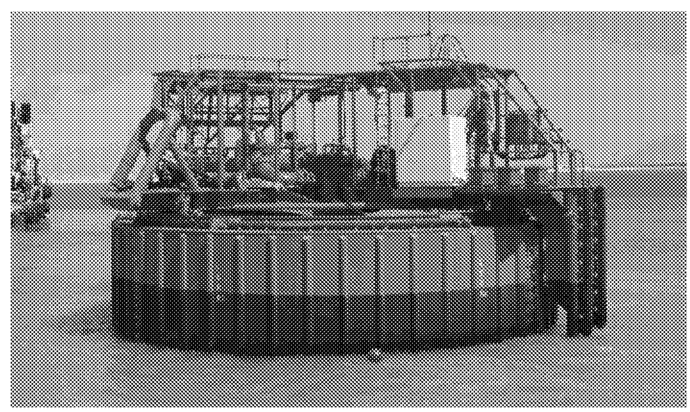
280 Mooring Systems in Operation

30 years
without drydock

24/7 Hotline Assistance

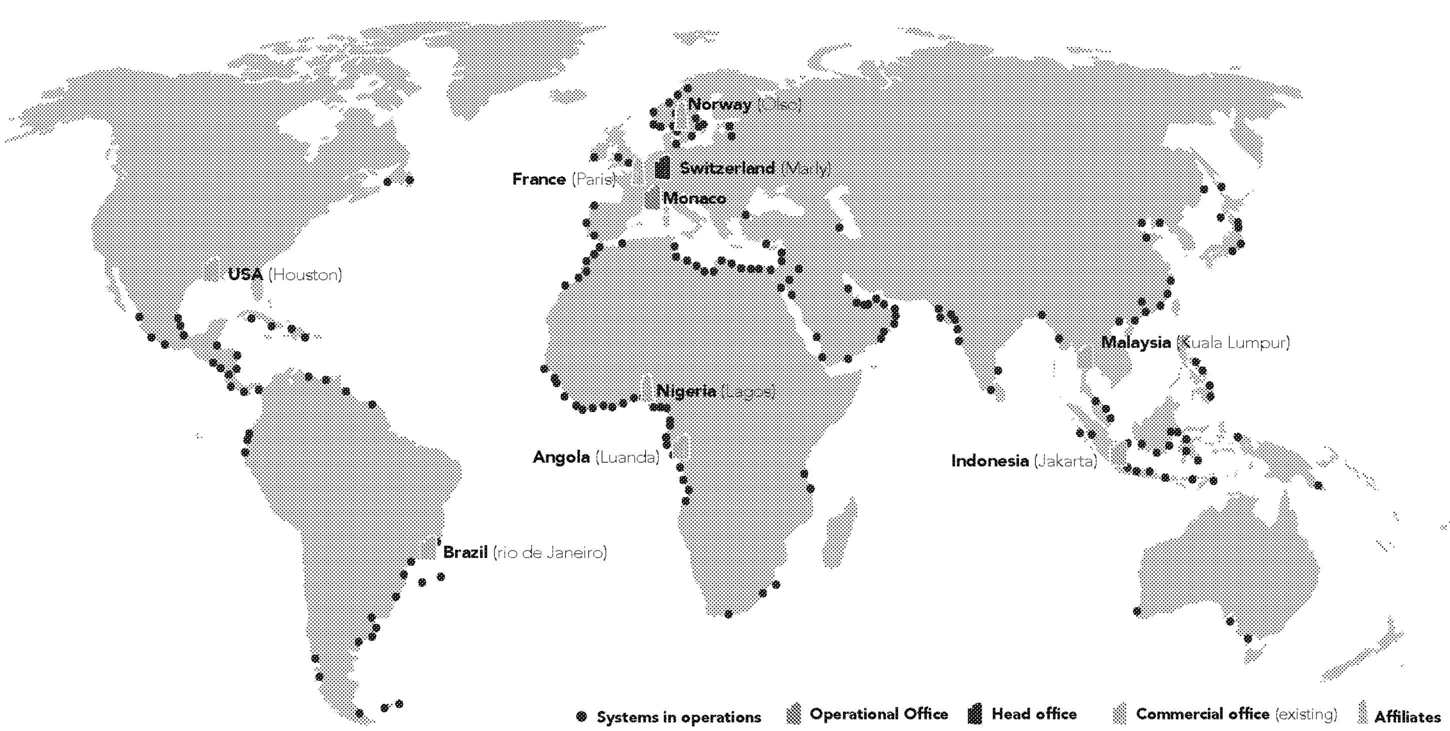


Turntable Main Roller Bearing CALM



Turntable Wheel & Rail CALM

Our global presence



Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1958	1	Sweden	Dalarö	Royal Swedish Navy	CALM	S	1x4"	1	3,000	8	
1959	2	Malaysia	Miri	Shell	CALM	EL	2x8" + 1x6"	2	70,000	15	
1961	3	Spanish Sahara	El Aaiun	Cepsa	CALM	R	1x6"		3,000	9	
1962	4	Malaysia	Miri	Shell	CALM	EL	2x8" + 1x6"	2	70,000	15	
1962	5	Malaysia	Miri	Shell	CALM	R	2x12" + 1x6"	2	70,000	15	
1962	6	West Germany	Baltic Sea	West Germany Navy	CALM	S	1x4"	1	2,000	8	
1962	7	Malaysia	Port Dickson	Shell	CALM	R	2x16"	1	100,000	27	
1963	8	Italy	Fiumicino	Purfina	CALM	R	2x12"	1	50,000	15	
1963	9	Italy	Ravenna	Sarom	CALM	R	2x12"	1	50,000	-	
1963	10	Malaysia	Miri	Shell	CALM	R	2x12" + 1x6"	4	70,000	16	
1963	11	Oman	Mina-al-Fahal	Shell	CALM	EL	2x8"	2	100,000	22	
1963	12	Japan	Oita	Kyusha Oil Corp.	CALM	R	2x12"	1	100,000	54	
1963	13	Spanish Guinea	Bata	Cepsa	CALM	R	1x6"	1	20,000	12	
1963	14	Korea	Ulsan	Koco	CALM	R	1x4" + 1x8" + 2x12"	3	75,000	20	
1965	15	Libya	Ras-es-Sider	Oasis	CALM	EL	3x16"	1	100,000	31	
1965	16	Japan	Chiba	Maruzen Oil Corp.	CALM	R	3x12"	1	100,000	-	
1965	17	Qatar	Halul	Shell	CALM	EL	2x16"	1	100,000	30	
1965	18	Gabon	Gamba Field	Shell	CALM	EL	1x16"	1	100,000	19	
1966	19	Spain	Huelva	Rio Tinto	CALM	R	2x16"	1	100,000	23	
1966	20	Oman	Mina-al-Fahal	Shell	CALM	EL	2x16" + 1x8"	3	165,000	35	
1966	21	Oman	Mina-al-Fahal	Shell	CALM	EL	2x20" + 2x8"	3	165,000	38	
1967	22	France	Bay of Biscay	Elf	AC	S	-	-	-	98	Prototype
1967	23	Japan	Koshiba	U.S. Army	CALM	S	2x12"	2	100,000	20	
1967	24	Philippines	Subic Bay	U.S. Army	CALM	S	1x10" + 2x16"	4	108,000	26	
1967	25	Gabon	Lucina Field	Shell	CALM	E	1x16"	1	165,000	34	
1967	26	Taiwan	Tai-Chung (I)	U.S. Air Force	CALM	S	1x12"	2	50,000	23	
1967	27	Bangladesh	Chittagong	Chittagong Port Trust	CALM	S	1x12"	1	45,000	14	
1967	28	Nigeria	Lagos	Nidogas	LPG CALM	EL	1x3" + 1x4"	2	2,000	4	
1968	29	Egypt	Ras-el-Shaqiq	Wepco	CALM	EL	2x16"	2	100,000	24	
1968	30	Angola	Malongo	Gulf	CALM	EL	2x16"	2	100,000	23	
1968	31	Taiwan	Kaohsiung	CPC	CALM	R	1x10" + 2x16"	3	100,000	21	
1968	32	Taiwan	Tai-Chung (II)	U.S. Air Force	CALM	S	1x12"	2	50,000	23	
1968	33	Libya	Zuetina	Occidental	CALM	EL	1x24"	1	100,000	30	
1968	34	Venezuela	Moron	CVP	CALM	R	2x16"	1	100,000	19	
1968	35	Japan	Hakozaki	U.S. Army	CALM	S	1x10" + 1x12" + 2x16"	5	100,000	18	
1968	36	Libya	Zuetina	Occidental	CALM	EL	2x24"	1	150,000	32	
1968	37	Libya	Zuetina	Occidental	CALM	EL	2x24"	1	150,000	32	
1968	38	Nigeria	Forcados	Shell	CALM	EL	1x20"	1	210,000	25	
1968	39	Nigeria	Forcados	Shell	CALM	EL	1x24"	1	210,000	25	

Legend
*Application Keys: R = Refinery – EL = Export from Land – E = Export from Offshore Field – N/A= Not Available – S = Special Application – FS = Floating Storage – FSO = Floating Storage & Offloading * Nr of Fluid Swivel Circuit

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1968	40	Nigeria	Escravos	Gulf	CALM	EL	2x16"	2	100,000	21	
1968	41	United Arab Emirates	Fateh Field, Dubai	Conoco	CALM	E	2x16"	1	150,000	31	
1968	42	Brazil	Tramandaï	Petrobras	CALM	R	2x16"	1	105,000	22	
1968	43	Japan	Hakodate	Asia Oil Corp.	CALM	R	1x16"	1	32,000	15	
1969	44	South Africa	Durban	Shell	CALM	R	2x20"	1	210,000	46	
1969	45	Korea	Yosu	Honam Oil Refining Co.	CALM	R	2x16"	1	100,000	34	
1969	46	Canada	Saint John	Irving Oil	CALM	R	1x24" + 1x16"	1	350,000	45	Arctic operation
1969	47	Libya	Ras Lanuf	Mobil	CALM	EL	2x24"	2	255,000	29	
1969	48	Libya	Ras-es-Sider	Oasis	CALM	EL	2x24"	1	255,000	31	
1969	49	Korea	Ulsan (II)	Koco	CALM	R	1x12" + 2x16"	2	200,000	27	
1969	50	Japan	Toyama	Japan Sea Oil Co.	CALM	R	2x16"	4	150,000	-	
1970	51	United Kingdom	Tetney	Conoco	CALM	R	1x24"	1	210,000	23	
1970	52	Italy	Porto Torres	Sardoil	CALM	R	2x20"	1	255,000	31	
1970	53	Iran	Cyrus Field	Ipac	CALM	FSO	2x16"	2	140,000	43	Permanent barge mooring, side-by-side berthing
1970	54	Indonesia	Pank Kalan Susu	Pertamina	CALM	EL	2x12"	1	100,000	-	
1970	55	Argentina	Puerto Rosales	YPF	CALM	R	1x12" + 1x16"	2	40,000	18	
1970	56	Saudi Arabia	Zuluf Field	Aramco	CALM	FS	2x24" + 1x16"	2	250,000	34	Permanent tanker mooring
1970	57	Okinawa	Tengan	U.S. Army	CALM	S	2x12"	2	50,000	21	
1970	58	Saudi Arabia	Zuluf Field	Aramco	CALM	E	2x24"	1	450,000	39	
1970	59	Australia	Botany Bay	M.S.B. of N.S.W.	CALM	R	3x12"	3	120,000	19	
1970	60	Brazil	Tramandaï	Petrobras	CALM	R	1x24"	1	200,000	22	
1970	61	Nigeria	Escravos	Gulf	CALM	EL	2x24"	1	300,000	31	
1970	62	Norway	Ekofisk Field	Phillips	CALM	E	1x12"	1	60,000	71	North Sea operation
1970	63	Norway	Ekofisk Field	Phillips	CALM	E	1x12"	1	150,000	63	North Sea operation
1970	64	Okinawa	Buckner Bay	Toyo Gasoline	CALM	R	2x16"	1	100,000	-	
1970	65	Japan	Himeji	Idemitsu Oil	CALM	R	2x20"	2	220,000	-	
1971	66	Singapore	Singapore Harbour	Esso	CALM	R	2x24"	1	252,000	27	
1971	67	Taiwan	Ta-Lin-Pu	CPC	CALM	R	2x20"	4	250,000	30	
1971	68	Brunei	Seria	Shell	CALM	EL	2x16"	1	150,000	22	
1971	69	Iran	Iman Hasan	SIRIP	CALM	EL	2x16"	1	250,000	25	
1971	70	Morocco	Mohammedia	RAPC	CALM	EL	1x8" + 1x20"	2	100,000	22	
1971	71	New Zealand	Waipipi Point	Marcona Corp.	CALM	R	1x12"	2	75,000	20	First CALM for bulk ore slurry transfer
1971	72	Chile	Quintero Bay	Enap	CALM	R	2x20"	1	209,000	47	
1971	73	Dominican Rep.	Santo Domingo	Refidom S.A.	CALM	R	2x16"	2	150,000	26	
1971	74	Ecuador	Esmeraldas	Gulf/Texaco	CALM	EL	2x20"	2	100,000	38	
1971	75	Ecuador	Esmeraldas	Gulf/Texaco	CALM	EL	1x24" + 1x20"	2	100,000	38	
1971	76	Trinidad	Galeota Point	Amoco	CALM	R	2x20"	2	250,000	29	
1971	77	Nigeria	Qua Iboe Terminal	Mobil	CALM	EL	2x24"	1	255,000	27	

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1971	78	Nigeria	Forcados	Shell	CALM	EL	1x24"	1	313,000	28	
1971	79	Nigeria	Bonny	Shell	CALM	EL	1x24"	1	313,000	28	
1971	80	Nigeria	Bonny	Shell	CALM	EL	1x24"	1	313,000	28	
1971	81	Indonesia	Balikpapan	Unocal	CALM	R	2x20" + 1x16"	2	250,000	31	
1971	82	Denmark	Dan Field	Danbor	CALM	E	1x12"	2	70,000	46	North Sea operation
1971	83	Tanzania	Dar-es-Salaam	Tanzania Harbor Authority	CALM	R	2x20"	2	100,000	24	
1971	84	Spain	Amposta Field	Shell	CALM	FSO	2x10" + 1x6"	2	33,500	64	Permanent tanker mooring for an FSO, side-by-side berthing
1971	85	Indonesia	Java Sea	IIAPCO	CALM	EL	2x12"	2	55,000	37	
1972	86	Abu Dhabi	Mubarras Island	ADOC	CALM	EL	1x24"	1	200,000	18	
1972	87	United Kingdom	Auk Field	Shell	ELSBM	E	1x10"	1	42,000	85	North Sea operation, SPAR buoy, helideck
1972	88	New Zealand	Taharoa	New Zealand Steel	CALM	S	1x12"	2	70,000	23	CALM for bulk ore slurry transfer
1972	89	Taiwan	Taoyuan	CPC	CALM	R	2x20"	1	250,000	35	
1972	90	United Arab Emirates	Das Island, Abu Dhabi	BP	CALM	EL	1x16" + 2x24"	2	300,000	29	
1972	91	Qatar	Umm Said	Qatar Petroleum	CALM	EL	1x20" + 1x24"	1	300,000	20	
1972	92	Congo	Djeno	Elf	CALM	EL	2x20"	2	250,000	23	
1972	93	Indonesia	Java Sea	Arco	CALM	FS	1x12" + 1x16"	2	133,000	41	Permanent mooring for a storage barge
1972	94	Nigeria	Brass River	Agip	CALM	EL	2x20"	1	200,000	29	
1972	95	Indonesia	Java Sea	IAAPCO	CALM	FS	2x20"	4	133,000	40	Permanent mooring for a storage barge
1973	96	United Kingdom	Brent Field	Shell	AC	S	-	-	-	137	Flare
1973	97	Oman	Mina-al-Fahal	Shell	CALM	EL	2x20" + 2x8"	2	500,000	47	
1973	98	United Kingdom	Argyll Field	Hamilton	CALM	E	1x12"	1	100,000	77	North Sea operation
1973	99	Indonesia	Djatibarang Field	Pertamina	CALM	E	3x20"	2	150,000	23	
1973	100	Mexico	Tuxpan (I)	Pemex	CALM	R	2x16"	2	60,000	18	
1973	101	United Arab Emirates	Abu-al-Bu-Koosh Field, Abu Dhabi	Total/ABK	CALM	FSO	2x10"	1	100,000	30	Permanent tanker mooring for an FSO, side-by-side berthing
1973	102	Spain	Tarragona	Enpetrol	CALM	R	2x24" + 1x12"	2	325,000	41	
1973	103	United Arab Emirates	Mubarek Field, Sharjah	Crescent	CALM	E	2x20" + 1x16"	2	350,000	49	
1973	104	Trinidad	Point-A-Pierre	Texaco	CALM	R	1x12" + 2x24"	3	260,000	24	
1973	105	Indonesia	Ardjuna Field	Atlantic Richfield Co	CALM	FS	3x16"	3	150,000	42	Permanent tanker mooring
1973	106	Indonesia	Ardjuna Field	Atlantic Richfield Co	CALM	E	2x16"	1	200,000	38	
1973	107	France	Frontignan	Mobil	CALM	R	2x20"	1	270,000	31	
1974	108	Malaysia	Labuan	Shell	CALM	EL	2x20"	1	313,000	30	
1974	109	Indonesia	Bekapai Field	Total	CALM	FSO	2x8"	1	100,000	37	Permanent tanker mooring for an FSO, side-by-side berthing
1974	110	Norway	Frigg Field	Elf	AC	S	-	-	-	106	Flare
1974	111	Mexico	Tuxpan (II)	Pemex	CALM	R	1x10" + 3x16"	4	60,000	20	

Legend
*Application Keys: R = Refinery – EL = Export from Land – E = Export from Offshore Field – N/A= Not Available – S = Special Application – FS = Floating Storage – FSO = Floating Storage & Offloading * Nr of Fluid Swivel Circuit

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1974	112	United Kingdom	Montrose Field	Amoco	CALM	E	1x10"	1	50,000	93	North Sea operation
1974	113	United Kingdom	Montrose Field	Amoco	CALM	E	1x10"	1	50,000	93	North Sea operation
1974	114	Nigeria	North Apoi Field	Texaco	CALM	FS	2x20" + 1x12"	2	50,000	27	Permanent tanker mooring
1974	115	Nigeria	North Apoi Field	Texaco	CALM	E	2x20"	1	250,000	28	
1974	116	United Kingdom	Anglesey	Shell	CALM	R	2x24" + 1x16"	2	550,000	39	Dual underbuoy Flexpipe
1974	117	United Kingdom	Beryl 'A' Field	Mobil	ALP	E	1x16"	1	80,000	117	Tower with loading boom and helideck
1974	118	South Africa	Durban	Shell	CALM	R	1x20"	1	210,000	46	
1974	119	Egypt	Ain Sokhna	Sumed	CALM	S	2x20"	1	120,000	25	Transit pipeline terminal
1974	120	Egypt	Sidi Kerir	Sumed	CALM	S	2x20" + 1x16"	2	120,000	26	Transit pipeline terminal
1974	121	Egypt	Sidi Kerir	Sumed	CALM	S	2x20" + 1x16"	2	120,000	25	Transit pipeline terminal
1974	122	Egypt	Sidi Kerir	Sumed	CALM	S	2x20" + 1x16"	2	120,000	25	Transit pipeline terminal
1974	123	Tunisia	Ashtart Field	Elf	CALM	E	1x20"	2	100,000	67	
1975	124	Argentina	Caleta Olivia	YPF	CALM	R	1x12" + 1x20"	2	60,000	34	
1975	125	United Kingdom	Brent Field	Shell	SPAR	FSO	1x12"	2	110,000	140	North Sea operation, SPAR buoy, loading boom and helideck
1975	126	Brunei	Seria	Shell	CALM	EL	2x20"	1	210,000	20	
1975	127	India	Bombay High Field	ONGC	CALM	FS	1x16" + 1x8"	2	100,000	73	Permanent tanker mooring
1975	128	Zaire	Muanda Field	Gulf	CALM	E	2x16"	1	100,000	22	
1975	129	India	Bombay High Field	ONGC	CALM	E	1x16"	1	100,000	73	
1975	130	United Kingdom	Thistle Field	BNOC	SALM	E	2x16"	2	80,000	163	North Sea operation, Tubular Riser
1975	131	Uruguay	Jose Ignacio	Ancap	CALM	R	2x24"	1	150,000	20	
1976	132	Norway	Statfjord 'A'	Mobil	ALP	E	1x20"	1	100,000	145	Tower with loading boom and helideck
1976	133	Libya	Azzawiya	NOC	SALM	R	2x20"	2	140,000	30	Chain Riser
1976	134	Libya	Azzawiya	NOC	SALM	R	2x20"	2	100,000	26	Chain Riser
1976	135	Egypt	Agami	EGPC	CALM	EL	2x16"	1	100,000	30	
1976	136	Brazil	Sao Francisco Do Sul	Petrobras	CALM	E	2x20"	2	200,000	22	
1976	137	Nigeria	Brass River	Agip	CALM	EL	2x20"	1	250,000	29	
1976	138	Egypt	Suez	Sumed	CALM	S	2x24"	1	250,000	24	
1976	139	Indonesia	Handil Field	Total	CALM	EL	2x20"	1	125,000	32	
1976	140	New Zealand	Taharoa	N.Z. Steel Ltd.	CALM	S	2x12"	1	150,000	32	Ironsand slurry
1976	141	Egypt	Ain Sokhna	Sumed	CALM	S	2x24"	1	250,000	24	
1976	142	Egypt	Alexandria	Sumed	CALM	S	2x24" + 1x20"	2	250,000	33	
1976	143	Egypt	Alexandria	Sumed	CALM	S	2x24" + 1x20"	2	250,000	33	
1976	144	Mexico	Salina Cruz	Pemex	CALM	S	3x16" + 1x12"	4	60,000	23	
1976	145	Zaire	Muanda Field	Gulf	CALM	FS	2x16"	2	79,200	24	Permanent mooring for a storage tanker
1976	146	Mexico	Rosarito Beach	Pemex	CALM	R	1x20" + 2x16"	2	60,000	23	

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1976	147	Trinidad	Galeota Point	Amoco	CALM	R	2x20"	2	250,000	29	
1976	148	Taiwan	Chu-Wei	CPC	SALM	R	2x20"	1	250,000	37	Chain Riser
1977	149	New Caledonia	Noumea	Le Nickel	CALM	S	1x20"	1	100,000	19	Fuel oil supply
1977	150	India	Salaya	IOC	CALM	R	2x24"	2	300,000	35	
1977	151	Cameroon	Kole Field	Elf-Serepca	CALM	EL	1x20"	1	150,000	24	
1977	152	United Arab Emirates	Das Island, Abu Dhabi	ADMA	CALM	E	2x24" + 1x6"	2	300,000	29	Supplied from stock
1977	153	Nigeria	North Apoi Field	Texaco	CALM	E	2x24"	2	250,000	29	
1977	154	United Kingdom	Brent Field	Shell Expro	CALM	E	1x16"	1	80,000	140	North Sea operation, stand-by unit
1977	155	Indonesia	Balongan	Pertamina	CALM	R	2x20" + 1x16"	2	150,000	23	
1977	156	Nigeria	Escravos	Gulf	CALM	EL	2x24"	1	300,000	31	
1978	157	Brazil	Enchova Field	Petrobras	CALM	E	1x8"	1	53,000	125	
1978	158	Korea	Onsan	KIPCO	CALM	R	2x24"	1	250,000	27	
1978	159	Brazil	Garoupa Field	Petrobras	CALM	FPSO	2x10"	2	53,000	125	Permanent mooring for storage/ processing tanker
1978	160	Egypt	El Alamein	Wepco	CALM	EL	2x16"	2	100,000	21	
1978	161	Malaysia	Bintulu	Shell	CALM	EL	2x20"	1	210,000	20	
1978	162	Ecuador	Esmeraldas	Texaco	CALM	R	2x20"	2	200,000	36	Supplied from stock
1978	163	Mexico	Rabon Grande	Pemex	CALM	R	1x16" + 2x20"	2	150,000	27	Supplied from stock
1979	164	Angola	Quinfuquena	Petrangol	RC	E	2x16"	1	150,000	21	
1979	165	Oman	Mina-al-Fahal	Shell	CALM	EL	2x20" + 1x12"	2	350,000	38	Supplied from stock
1979	166	Norway	Statfjord 'B' Field	Mobil	ALP	E	1x20"	1	150,000	146	Tower with loading boom and helideck
1979	167	Cameroon	Pointe Limboh	Sonara	CALM	R	2x16" + 1x16"	2	150,000	23	
1979	168	United Kingdom	Buchan Field	BP	CALM	E	1x12"	1	107,000	112	
1979	169	Nigeria	Qua Iboe	Mobil	CALM	EL	2x24"	1	300,000	26	
1979	170	Brazil	Tedut and Tefran	Petrobras	CALM	R	2x20"	2	200,000	22	Stand-by unit
1979	171	Gabon	Gamba Field	Shell	CALM	E	1x16" + 1x10"	1	140,000	19	
1979	172	Denmark	Gorm Field	Danbor	CALM	E	2x12"	2	70,000	39	North Sea operation
1979	173	Qatar	Halul	QGPC	CALM	EL	2x20" + 1x10"	2	540,000	37	
1979	174	Argentina	Caleta Cordova	YPG	CALM	R	1x20" + 1x12"	2	60,000	27	
1979	175	Libya	Zuetina	Occidental	CALM	EL	2x24"	1	275,000	30	
1979	176	United Arab Emirates	Fateh Field, Dubai	DUPETCO	CALM	FSO	2x20"	2	120,000	40	Permanent mooring for an FSO
1979	177	Taiwan	Chu-Wei	CPC	CALM	R	2x20"	1	250,000	37	
1980	178	Norway	N.E. Frigg Field	Elf	AC	S	-	-	-	97	Field control station
1980	179	Mexico	Rabon Grande	Pemex	CALM	EL	2x20" + 1x16"	2	250,000	28	Supplied from stock
1980	180	Mexico	Dos Bocas	Pemex	CALM	EL	2x20" + 1x16"	2	250,000	28	
1980	181	Indonesia	Semarang	Pertamina	CALM	S	1x16"	1	17,000	12	Fuel oil supply

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Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1980	182	Angola	Malongo	Gulf	CALM	FSO	1x4"	1	55,000	36	Permanent tanker mooring for an FSO(LPG), side-by-side berthing
1980	183	Mexico	Salina Cruz	Pemex	CALM	R	1x20" + 2x16"	3	60,000	-	
1980	184	Mexico	Dos Bocas	Pemex	CALM	R	2x24"	1	250,000	59	
1980	185	Argentina	Punta Cigüena	YPF	CALM	R	1x20" + 1x12"	2	60,000	-	
1980	186	France	Brittany	French Navy	AC	S	1x20"	1	25,000	89	Recovery of oil from sunk ship
1980	187	Libya	Ras-es-Sider	Oasis	CALM	EL	2x24"	2	300,000	31	
1980	188	Angola	Takula Field	Gulf	CALM	E	2x12"	2	300,000	67	
1980	189	Egypt	Ras Budran	Suez Oil Co.	CALM	EL	1x24" + 1x20"	2	250,000	35	
1980	190	United Kingdom	Tetney	Conoco	CALM	R	1x24"	1	280,000	23	
1980	191	USA	Worldwide	US Navy	CALM	S	2x10"	2	70,000	20-61	Rapid Deployment
1980	192	United Kingdom	Maureen Field	Phillips	ALP	E	1x16"	1	85,000	103	Tower with loading boom and helideck
1980	193	Angola	Essungo	Texaco	CALM	FSO	2x20" + 1x16"	2	250,000	35	Permanent mooring for an FSO
1980	194	Singapore	Singapore Harbour	PSA	CALM	R	2x24"	1	300,000	32	
1980	195	Ivory Coast	Bouet	SIR	CALM	R	3x24"	2	250,000	50	
1980	196	Mexico	Abkatun	Pemex	CALM	FSO	2x24" + 1x16"	2	151,000	37	Permanent mooring for an FSO
1981	197	Indonesia	Ardjuna Field	Atlantic Richfield Co	CALM	FS	1x6"	1	56,000	41	Permanent tanker mooring, butane
1981	198	United Kingdom	Beryl 'A' Field	Mobil	CALM	E	1x20"	1	85,000	120	North Sea operation, stand-by unit. Supplied from stock
1981	199	Italy	Rospo Mare	Elf	CALM	FSO	1x10"	1	35,000	75	Permanent mooring for an FSO
1981	200	United Kingdom	Beryl 'B' Field	Mobil	ALP	E	1x16"	1	90,000	118	Tower with loading boom and helideck
1981	201	Indonesia	Cinta Field	IIAPCO	CALM	FSO	2x12" + 2x20"	4	133,000	40	Permanent mooring for an FSO
1981	202	United Arab Emirates	Zakum Field (1), Abu Dhabi	ZADCO	CALM	E	2x20" + 1x20"	2	250,000	29	
1981	203	United Arab Emirates	Zakum Field (2), Abu Dhabi	ZADCO	CALM	E	2x20" + 1x20"	2	250,000	29	
1981	204	Brazil	Pampo Field	Petrobras	CALM	E	1x16"	1	53,000	140	
1981	205	Brazil	RJS 28A Field	Petrobras	CALM	E	1x16"	1	53,000	120	
1981	206	United Arab Emirates	Hamriyah Field , Sharjah	Amoco	CALM	EL	1x20"	2	300,000	20	Supplied from stock
1981	207	Abu Dhabi	Abu-al-Bu-Koosh Field	Total/ABK	CALM	FSO	2x10"	2	232,000	28	Permanent tanker mooring, tandem berthing
1981	208	Cameroon	Kole Field	Elf Serepca	CALM	EL	2x24" + 1x16"	2	250,000	26	Supplied from stock
1981	209	Malaysia	Trengganu	Exxon (EPMI)	SALM	EL	1x24"	1	250,000	28	Chain Riser
1981	210	Malaysia	Trengganu	Exxon (EPMI)	SALM	EL	1x24"	1	250,000	26	Chain Riser
1981	211	Egypt	Ain Sokhna	Sumed	CALM	S	2x24" + 1x16"	2	500,000	36	Transit pipeline terminal
1981	212	Mexico	Cayou Arcas	Pemex	RC	FSO	2x20"	2	285,000	41	Permanent tanker mooring, side-by-side berthing

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1981	213	Taiwan	Ta-Lin-Pu	CPC	CALM	R	2x24" + 1x16"	2	250,000	40	
1981	214	Mexico	Dos Bocas	Pemex	CALM	R	2x24" + 1x16"	2	250,000	28	Supplied from stock
1981	215	Indonesia	Balikpapan	Pertamina	CALM	R	2x16"	1	150,000	31	
1981	216	Brazil	Badejo Field	Petrobras	CALM	FSO	2x10"	2	53,000	103	Permanent mooring for an FSO
1981	217	Panama	Chirique Grande	PTP	CALM	R	2x20"	2	150,000	24	
1981	218	Panama	Chirique Grande	PTP	CALM	R	2x20"	2	150,000	22	
1982	219	Brazil	Corvina Field	Petrobras	CALM	E	2x8"	2	53,000	150	High pressure and low pressure crude swivels
1982	220	India	Ratnagirir Field	ONGC	CALM	FSO	1x16" + 2x20"	2	115,000	41	Permanent mooring for an FSO
1982	221	Norway	Statfjord 'C' Field	Mobil	ALP	E	1x20"	1	150,000	146	Tower with loading boom and helideck
1982	222	Cameroon	Victoria Marine Field	Total	CALM	E	1x24"	1	280,000	57	
1982	223	Egypt	Sidi Kerir	Sumed	CALM	EL	2x24" + 1x20"	2	250,000	33	Supplied from stock. Lease
1982	224	Middle East	-	-	CALM	-	2x24"	2	350,000	26	
1982	225	Middle East	-	-	CALM	-	2x24"	2	350,000	26	
1982	226	Brazil	Pampo Field	Petrobras	CALM	E	1x8"	1	53,000	110	
1983	227	Egypt	El Zeit Bay	Suez Oil Co.	CALM	EL	2x20"	1	165,000	37	
1983	228	Panama	Chirique Grande	PTP	CALM	R	2x20"	2	150,000	24	
1983	229	Tanzania	Dar-es-Salaam	Tanzania Harbor Authority	CALM	R	2x20"	2	100,000	27	Supplied from stock
1983	230	India	Bombay High Field	ONGC	CALM	FSO	1x16"	1	115,000	73	Permanent mooring for an FSO
1983	231	Indonesia	Balongan	Pertamina	CALM	R	1x16"	1	35,000	14	
1983	232	Iran	Iman Hassan	IOOC	CALM	EL	2x20" + 1x16"	2	250,000	25	
1983	233	Qatar	Umm Said	QGPC	CALM	EL	1x24" + 1x20"	2	350,000	20	Terminal supplied from stock
1983	234	Norway	Gullfaks Field	Statoil	ALP	E	1x20"	1	150,000	140	Tower with loading boom and helideck
1983	235	Norway	Gullfaks Field	Statoil	ALP	E	1x20"	1	150,000	30	Tower with loading boom and helideck
1983	236	United Arab Emirates	Saleh Field, Ras Al Khaimah	Gulf	CALM	FSO	1x8"	2	300,000	31	Permanent mooring for an FSO
1983	237	Libya	Es Sider	Oasis	CALM	EL	2x16"	1	250,000	38	Supplied from stock
1984	238	Oman	Kuria-Muria	Shell	CALM	EL	2x20"	2	350,000	38	Supplied from stock
1984	239	Indonesia	Tanjung Paser	Pertamina-PDN	CALM	R	2x12"	1	35,000	21	
1984	240	India	Vadinar	India Oil Co.	CALM	R	2x24"	1	300,000	31	
1984	241	Uruguay	Jose Ignacio	Ancap	CALM	R	2x24"	1	150,000	20	
1984	242	Malaysia	Miri	Shell	CALM	EL	2x20"	1	250,000	30	
1984	243	Korea	Jiseapo	Pedco	CALM	R	2x24" + 1x16"	2	250,000	33	
1984	244	Egypt	East Zeit	Esso Suez	CALM	EL	1x16" + 1x12"	2	85,000	29	
1984	245	United Arab Emirates	Fateh Field, Dubai	DPC/Conoco	CALM	E	2x20"	2	300,000	49	Supplied from stock
1984	246	N/A	N/A	UK Government	CALM	S	4x10" + 1x6"	5	45,000	16	Discharge White Products

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Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1984	247	Libya	Marsa el Brega	Sirte Oil	CALM	EL	1x24"	2	300,000	45	
1984	248	Malaysia	Miri	Shell	CALM	EL	-	1	-	-	Stand-by unit
1984	249	N/A	N/A	UK Government	SALM	S	2x24"	1	550,000	38	Chain Riser
1984	250	N/A	N/A	UK Government	SALM	S	2x24"	1	550,000	38	Chain Riser
1985	251	Angola	Takula Field	Gulf	CALM	E	2x16"	2	300,000	72	Supplied from stock
1985	252	Iran	Bushire	NIOC	CALM	EL	2x20"	1	250,000	24	Supplied from stock
1985	253	India	Panna Field	ONGC	CALM	E	1x16"	1	115,000	45	
1985	254	Libya	Marsa el Brega	Sirte Oil	CALM	R	2x24"	2	300,000	45	
1985	255	Lebanon	Beirut	Electricity of Lebanon	SALM	S	1x16"	2	40,000	35	Fuel oil supply for power plant
1985	256	Iran	Persian Gulf	NIOC	CALM	EL	2x24" + 1x16"	2	250,000	26	Supplied from stock
1985	257	Iran	Persian Gulf	NIOC	CALM	EL	2x24" + 1x16"	2	250,000	30	Supplied from stock
1985	258	Iran	Persian Gulf	NIOC	CALM	EL	2x24" + 1x16"	2	250,000	29	
1985	259	Iran	Persian Gulf	NIOC	CALM	EL	2x24" + 1x16"	2	250,000	N/A	
1985	260	Iran	Persian Gulf	NIOC	CALM	EL	2x24" + 1x16"	2	250,000	N/A	
1985	261	Iran	Persian Gulf	NIOC	CALM	EL	2x24" + 1x16"	2	250,000	N/A	
1985	262	Iran	Persian Gulf	NIOC	CALM	EL	2x24" + 1x16"	2	250,000	N/A	
1985	263	Saudi Arabia	Assir	SWCC	CALM	S	1x16" + 1x12"	1	20,000	16	Fuel oil supply for desalination plant
1985	264	Indonesia	Bima Field	Atlantic Richfield Co	CALM	E	2x20" + 1x16"	2	250,000	34	
1985	265	Indonesia	Bima Field	Atlantic Richfield Co	CALM	E	2x20"	1	250,000	34	
1985	266	Indonesia	Bima Field	Atlantic Richfield Co	CALM	E	2x20" + 1x16"	2	250,000	34	Stand-by unit
1985	267	Malaysia	Miri	Shell	CALM	R	3x12"	3	100,000	14	
1985	268	Malaysia	Miri	Shell	CALM	R	3x12"	3	100,000	14	
1985	269	United Kingdom	Beryl 'A' Field	Mobil	ALP	E	1x16"	1	80,000	117	Tower with loading boom and helideck
1986	270	Saudi Arabia	Ras-al-Khafji	AOC	CALM	EL	1x24" + 1x10"	2	300,000	22	
1986	271	Sri Lanka	Colombo Harbour	Ceylon Petroleum Co.	CALM	R	1x24"	1	180,000	29	
1987	272	South Korea	Daesan	Kukdong Oil Co.	CALM	R	2x20"	2	250,00	31	
1987	273	Yemen	Ras Isa	YEPCO	CALM	FSO	1x12"	2	275,000	30	Permanent mooring for an FSO, side-by-side berthing. Supplied from stock.
1987	274	India	D-18	ONGC	CALM	EL	1x16"	1	115,000	91	
1987	275	Canada	Saint John	Irving Oil	CALM	R	1x24"	1	350,000	45	Arctic operation, electric swivel
1987	276	Argentina	Hidra Field	Total Austral	CALM	E	1x16"	1	130,000	34	
1987	277	Nigeria	Brass River	Agip	CALM	EL	2x20"	2	300,000	30	Supplied from stock
1988	278	Nigeria	Qua Iboe Terminal	Mobil	CALM	EL	2x24"	1	300,000	26	Lease
1988	279	Angola	Takula Field	Gulf	CALM	E	3x16"	2	300,000	72	Supplied from stock
1988	280	United Kingdom	Birch Field	Occidental	CALM	E	1x6"	1	63,000	128	North Sea operation, Extended Well Test System
1988	281	Angola	Malongo	Gulf	CALM	FSO	1x4"	1	55,000	36	Permanent mooring for an FSO (LPG), side-by-side berthing

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1988	282	Zaïre	Muanda	ZAGOC	CALM	FSO	2x16"	2	95,000	24	Permanent mooring for an FSO. Supplied from stock.
1989	283	Brazil	Marlim (1)	Petrobras	CALM	FSO	1x8"	1	120,000	400	Permanent mooring for an FSO. Shuttle tankers of 120 000 DWT.
1989	284	Brazil	Marlim (2)	Petrobras	CALM	FSO	1x8"	1	120,000	400	Permanent mooring for an FSO. Shuttle tankers of 120 000 DWT.
1989	285	Yemen	Bir Ali	Machinoimport	CALM	EL	1x10"	1	20,000	20	
1989	286	Iran	Taheri	NIOC	CALM	EL	1x16"	1	40,000	17	
1989	287	South Korea	Daesan	Kukdong Oil Co.	CALM	R	2x20"	2	250,000	31	
1989	288	Nigeria	Forcados	Shell	CALM	EL	2x24"	1	350,000	25	
1989	289	United Kingdom	Kittiwake Field	Shell	FLP	E	2x8"	1	120,000	79	Modification of Auk Field ELSBM.
1989	290	Italy	Emilio Field	Agip	CALM	E	1x6"	1	25,000	85	Extended Well Test system.
1990	291	Australia	Port Stanvac	Mobil	CALM	R	2x20" + 1x12"	2	300,000	25	
1990	292	Abu Dhabi	Jebel Dhanna	ADCO	CALM	EL	2x20"	1	450,000	20	
1990	293	Egypt	Sidi Kerir	Sumed	CALM	S	3x20"	2	350,000	35	Transit pipeline terminal
1990	294	United Kingdom	Worldwide	UK Ministry of Defense	CALM	S	1x8"	1	50,000	20-61	Rapid Deployment
1990	295	Egypt	Aine Sokhna	Sumed	CALM	S	3x24"	1	500,000	43	Transit pipeline terminal
1990	296	South Korea	Ulsan	Yukong Ltd.	CALM	R	2x16"	2	325,000	23	Supplied from stock
1990	297	Canada	Cohasset	Lasmo And Panuke Fields	CALM	FSO	1x6"	1	127,000	39	Permanent mooring for an FSO, tandem berthing. Supplied from stock.
1990	298	Falkland Islands	N/A	UK Government	CALM	S	4x10" + 1x6"	5	45,000	16	
1990	299	N/A	N/A	N/A	CALM	S	3x8"	3	50,000	22	
1991	300	Norway	Draugen Field	Norske Shell	FLP	E	1x16"	1	110,000	255	Column with loading boom and helideck, electric swivel
1991	301	Angola	Palanca Field	Elf	CALM	E	2x20"	1	280,000	43	
1991	302	Nigeria	Agbara Field	Agip	SBF	-	-	-	-	65	SPAR buoy flare
1991	303	Nigeria	Oso Field	Mobil	CALM	EL	2x24"	2	285,000	27	
1991	304	Angola	Malongo	Gulf	CALM	EL	2x24"	2	325,000	31	Supplied from stock
1991	305	Libya	Ras Lanuf	Veba	CALM	EL	2x20"	2	255,000	29	Supplied from stock
1992	306	Indonesia	Belida	Conoco	CALM	FSO	1x12" + 1x8"	1	175,000	76	Permanent mooring for an FSO
1992	307	Yemen	Masila	Canadian Oxy	CALM	EL	2x20"	1	300,000	44	
1992	308	Nigeria	Bellatrix Field	Agip	CALM	E	2x24" + 1x16"	2	285,000	30	Lease
1993	309	Indonesia	Cilacap	Pertamina	CALM	R	2x24"	1	250,000	35	
1993	310	Libya	Ras Lanuf	Veba	CALM	EL	2x16"	1	300,000	30	Supplied from stock
1993	311	Indonesia	Balongan Field	Pertamina	CALM	E	2x16" + 1x14"	3	40,000	14	
1993	312	Nigeria	Escravos	Chevron	CALM	EL	1x24"	1	300,000	31	Supplied from stock
1993	313	Thailand	Sri Racha	SIPM	CALM	R	2x20"	2	230,000	22	Supplied from stock
1993	314	United Arab Emirates	Sharjah	Amoco	CALM	EL	2x20"	2	300,000	20	

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Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1993	315	Colombia	Santa Marta	Ecopetrol	CALM	R	1x20"	1	70,000	28	
1994	316	Thailand	Map Ta Phut	STAR Petroleum	CALM	R	2x24"	2	280,000	24	
1994	317	Korea	Ulsan	Ssangyong	CALM	R	2x24" + 1x16"	2	385,000	27	Supplied from stock
1994	318	Korea	Ulsan	Pedco	CALM	R	2x24"	1	325,000	27	
1994	319	Zaire	Muanda Field	ZAGOC	CALM	E	2x16"	2	100,000	23	
1994	320	Oman	Mina-al-Fahal	Shell	CALM	EL	2x12"	2	100,000	22	
1994	321	Nigeria	Qua Iboe	Mobil	CALM	EL	2x24"	1	285,000	26	Lease
1994	322	India	Hazira	Reliance	CALM	R	1x16" + 1x10"	2	50,000	30	White Products
1994	323	Saudi Arabia	Jizan	Saudi Aramco	CALM	R	2x20"	3	45,000	17	White Products
1994	324	Saudi Arabia	Jizan	Saudi Aramco	CALM	R	2x20"	3	45,000	17	White Products
1995	325	Poland	B-3	Petrobaltic	CALM	S	1x6"	1	50,000	80	
1995	326	Nigeria	Bonny	Shell	CALM	EL	2x20"	1	350,000	28	
1995	327	Nigeria	Bonny	Shell	CALM	EL	2x20"	1	350,000	28	
1995	328	India	Vadinar	IOC	CALM	R	2x24"	2	300,000	31	
1995	329	Ireland	Whiddy Island	Bantry Terminals Ltd.	CALM	S	2x24"	2	320,000	29	Supplied from stock
1995	330	Korea	Ulsan	Yukong	CALM	R	2x24"	2	300,000	27	Supplied from stock
1996	331	Canada	Cohasset and Panuke Fields	Pancanadian	CALM	FSO	1x16"	1	127,000	39	Permanent mooring for an FSO, tandem berthing. Supplied from stock.
1996	332	Qatar	Arco Arab 'B'	Mansal	CALM	FSO	2x24" + 1x16"	2	170,000	28	Lease: Permanent mooring for an FSO, tandem berthing.
1996	333	Nigeria	Ngo Field	Abacan	CALM	E	1x20"	2	270,000	28	Supplied from stock
1996	334	Portugal	Leixos	Petrogal	CALM	R	2x24"	1	300,000	29	
1996	335	Indonesia	Cengkareng	Pertamina	CALM	R	2x16"	1	35,000	21	
1997	336	Malaysia	Melaka	MRC	CALM	R	2x24"	1	300,000	34	
1997	337	China	Maoming	Maoming Refinery	CALM	R	2x24" + 1x16"	2	250,000	35	Supplied from stock
1997	338	India	Jamnagar	Reliance	CALM	R	2x24"	1	350,000	32	
1997	339	India	Jamnagar	Reliance	CALM	R	2x24"	1	350,000	32	
1997	340	Qatar	Al-Shaheen	Maersk Oil	CALM	FSO	2x16"	2	300,000	58	Supplied from stock
1997	341	Turkey	Manavgat	DSI	CALM	EL	2x24"	1	250,000	79	Water export
1997	342	Turkey	Manavgat	DSI	CALM	EL	2x24"	1	250,000	79	Water export
1997	343	Cyprus	Vasilikos	Electricity Authority of Cyprus	CALM	S	2x16"	1	80,000	30	Fuel import for power plant
1997	344	China	Weizhou Field	CONHW	CALM	E	2x16"	2	60,000	22	
1997	345	Russia	Sakhalin	Sakhalin Energy	SALM	FSO	1x8"	1	158,000	32	
1998	346	Nigeria	Escravos	Chevron	CALM	EL	2x24"	1	300,000	31	Supplied from stock
1998	347	Equatorial Guinea	Zafiro Field	Mobil	CALM	E	2x24"	1	302,000	137	
1998	348	Angola	Kuito Field	Cabinda Gulf Oil Co	CALM	E	2x20"	2	320,000	415	Deepwater export buoy for an FPSO
1998	349	Nigeria	Brass	Agip	CALM	EL	2x20"	2	300,000	30	Supplied from stock
1999	350	Russia	Novorossiysk	Caspian Pipeline Consortium	CALM	EL	2x24"	2	300,000	56	
1999	351	Russia	Novorossiysk	Caspian Pipeline Consortium	CALM	EL	2x24"	2	300,000	57	
1999	352	Angola	Girassol Field	Elf	CALM	E	1x24" + 2x16"	1	400,000	1334	Deepwater export buoy for an FPSO
1999	353	Qatar	Halul	QGPC	CALM	EL	2x20" + 1x10"	2	550,000	37	

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
1999	354	India	Jamnagar/ Hazira	Reliance	CALM	R	2x24"	1	350,000	32	Supplied from stock
1999	355	India	PPN	Kier	CALM	S	1x16"	1	20,000	-	
2000	356	Nigeria	Atlas-Cove	Bilfinger & Berger	CALM	S	1x16"	2	50,000	17	Import of White products. Supplied from stock
2000	357	Nigeria	Amenam/ Kpono Field	Elf Production Nigeria Ltd.	CALM	E	1x24"	1	340,000	70	Export buoy for an FSO
2000	358	Argentina	Hidra, Tierra del Fuego	Total Austral	CALM	E	2x12"	1	150,000	39	
2001	359	India	Panna Field	ONGC	CALM	E	1x16"	1	115,000	45	
2001	360	Chile	Quintero Bay	RPC	CALM	R	2x20"	1	209,000	47	
2001	361	Nigeria	Bonga Field	SNEPCO	CALM	E	2x20"	1	340,000	1006	Deepwater export buoy for an FPSO
2001	362	Kuwait	Mina Saud	Saudi Arabian Texaco	CALM	EL	1x24"	2	400,000	20	Supplied from stock
2001	363	Sri Lanka	Muthurajawela	Ceylon Petroleum Co.	CALM	R	1x16"	1	60,000	18	
2001	364	Indonesia	Belanak Field	Conoco	CALM	E	1x20"	1	150,000	90	
2001	365	Yemen	Mukala	Canadian Nexen	CALM	EL	2x20"	1	320,000	44	
2001	366	Saudi Arabia	Ras-al-Khafji	AGOC	CALM	EL	1x24"	1	300,000	22	
2002	367	Angola	Kizomba 'A'	ExxonMobil	CALM	E	2x20"	1	330,000	1187	Deepwater export buoy for an FPSO
2002	368	Nigeria	Okono	Agip	CALM	E	1x24"	1	330,000	75	Export buoy for an FPSO
2002	369	Qatar	Al-Rayyan	Anadarko	CALM	FSO	1x10"	1	285,000	28	Permanent mooring for an FSO
2003	370	United Kingdom	Tetney	Conoco	CALM	R	1x24"	1	165,000	23	
2003	371	Angola	Malongo	CABGOC	CALM	EL	2x16"	2	320,000	23	
2003	372	Nigeria	Erha	ExxonMobil	CALM	E	2x24"	1	350,000	1158	Deepwater export buoy for an FPSO
2003	373	Angola	Kizomba 'B'	ExxonMobil	CALM	E	2x20"	1	330,000	1023	Deepwater export buoy for an FPSO
2003	374	India	Ravva	Cairn Energy	CALM	E	2x20"	1	120,000	25	
2003	375	Iran	Assaluyeh	NIOC	CALM	E	2x20"	2	300,000	38	Export of condensate
2003	376	Russia	Prigordnoye	Sakhalin Energy	RC	EL	1x20"	1	150,000	29	
2003	377	India	Mundra Port	Gujarat Adani	CALM	R	2x24"	1	320,000	34	
2003	378	Yemen	Ash Shihr	Canadian Nexen	CALM	EL	2x20"	1	320,000	44	
2004	379	China	Shuidong	Maoming Refinery	CALM	R	2x24" + 1x16"	2	250,000	35	
2004	380	United Arab Emirates	Hamriyah Field , Sharjah	BP	CALM	EL	1x20"	1	300,000	20	Export of condensate
2004	381	Nigeria	Bonny	Shell	CALM	EL	1x24"	1	313,000	28	
2004	382	Ghana	Tema	Trafigura	CALM	R	1x16"	1	155,000	25	
2004	383	India	Sagar Lakshmi	EIL	CALM	FSO	1x8"	1	125,000	85	Permanent mooring for an FSO
2004	384	India	Paradip	IOCL	CALM	R	2x24"	1	320,000	30	
2004	385	Indonesia	Balongan	Pertamina	CALM	R	2x24"	1	150,000	25	
2004	386	Indonesia	Balongan	Pertamina	CALM	R	1x16"	1	35,000	16	
2004	387	Korea	Ulsan	SK Oil	CALM	R	2x16"	1	300,000	23	
2005	388	Angola	Greater Plutonio	BP	CALM	E	2x16"	1	350,000	1250	Deepwater export buoy for an FPSO
2005	389	Libya	Mellitah	Soilmare	CALM	EL	1x24"	1	160,000	30	
2005	390	Trinidad	Galeota	BP	CALM	R	2x24"	2	250,000	29	Supplied from stock
2005	391	Libya	Ras El Sider	Waha Oil Company	CALM	EL	2x24"	1	305,000	30	Supplied from stock

Legend
*Application Keys: R = Refinery – EL = Export from Land – E = Export from Offshore Field – N/A= Not Available – S = Special Application – FS = Floating Storage – FSO = Floating Storage & Offloading * Nr of Fluid Swivel Circuit

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
2005	392	Nigeria	Antan	Addax	CALM	EL	1x20"	1	350,000	42	
2005	393	Nigeria	Agbami	Chevron	CALM	E	2x24"	1	315,000	1370	Deepwater export buoy for an FPSO
2005	394	Nigeria	Akpo	Total	CALM	E	1x24"	1	350,000	1300	Deepwater export buoy for an FPSO
2005	395	Indonesia	Belanak Field	ConocoPhillips	CALM	FSO	2x6"	2	78,000 (m^3)	100	Permanent mooring for an LPG FSO
2005	396	Nigeria	Escravos EGP3	Chevron	CALM	E	2x16"	3	120,000	25	
2006	397	USA	GoM	BP	CALM	R	1x8"	1	120,000	134	Supplied from stock
2006	398	USA	GoM	BP	CALM	R	1x8"	1	120,000	134	Supplied from stock
2006	399	India	Jamnagar	Reliance	CALM	R	2x24"	1	350,000	31	
2006	400	India	Jamnagar	Reliance	CALM	S	2x20"	2	150,000	27	Export of gasoline and diesel
2006	401	India	Jamnagar	Reliance	CALM	S	2x20"	2	150,000	27	Export of diesel
2006	402	Brazil	Pra-1	Petrobras	CALM	E	2x20"	2	322,000	85	Deepwater export Buoy for an FPSO
2006	403	Brazil	Pra-1	Petrobras	CALM	E	2x20"	2	322,000	90	Deepwater export Buoy for an FPSO
2006	404	Vietnam	Dung Quat	Technip	CALM	R	2x16"	2	110,000	30	
2006	405	Cameroon	Kole	Total	CALM	FSO	2x24"	2	150,000	24	Supplied from Stock - FSO mooring.
2006	406	Nigeria	Qua Iboe	Mobil	CALM	EL	2x20"	1	320,000	28	
2006	407	Nigeria	Escravos	Chevron	CALM	E	1x16"	1	300,000	22	New built based on stock buoy design
2006	408	Nigeria	Pennington	Chevron	CALM	E	2x24"	2	310,000	31	New built based on stock buoy design
2007	409	Spain	Castellon	BP	CALM	R	2x24"	1	350,000	30	Supplied from Stock
2007	410	Nigeria	Forcados	Shell	CALM	R	2x20"	1	350,000	28	Supplied from Stock
2007	411	Angola	Palanca	Sonangol	CALM	E	2x20"	1	325,000	43	Supplied from Stock
2007	412	United Arab Emirates	Zirku Island, Zakum	Zadco	CALM	R	2x24"	2	300,000	30	
2007	413	India	Heera	ONGC	CALM	EL	2x8"	1	115,000	80	
2007	414	Japan	Okinawa	US Navy	CALM	R	2x12"	1	90,000	21	Aviation Fuel
2007	415	Angola	Malongo	CABGOC	CALM	EL	2x20"	1	325,000	30	
2007	416	Angola	Malongo	CABGOC	CALM	EL	2x20"	1	325,000	35	
2007	417	India	Mumbai High	ONGC	CALM	FSO	1x8"	1	125,000	80	
2008	418	United Arab Emirates	Zirku Island, Zakum	Zadco	CALM	R	2x20"	1	350,000	28	
2008	419	Spain	Huelva, L Rabida Refinery	CEPSA	CALM	R	2x16"	1	150,000	21	Import of crude oil
2008	420	Gabon	Gamba Terminal	Shell Gabon	CALM	EL	2x20"	1	160,000	24	Export of crude oil
2008	421	South Africa	Durban	SAPREF	CALM	S	2x24"	1	350,000	49	Import of crude oil
2008	422	Sri Lanka	Muthurajawela	Celon Petroleum Corporation (CPC)	CALM	R	2x16"	2	60,000	18	import of crude oil
2008	423	United Arab Emirates	Fujairah	Alstom	CBM	S	1x12"	1	40,000	20	Import of diesel oil
2008	424	Venezuela	Jose	PDVSA	CALM	EL	2x24"	2	320,000	30	Export of crude oil
2008	425	Chile	Quintero Bay	ENAP	CALM	R	2x20"	1	300,000	47	Replacement CALM from Stock for Crude Import
2008	426	Qatar		Oxy	CALM	FSO	2x20"	1	260,000	40	Permanent mooring for an FSO
2009	427	Saudi Arabia	Al Khafji	KJO	CALM	EL	1x24"	1	300,000	22	Export crude oil

Legend
*Application Keys: R = Refinery – EL = Export from Land – E = Export from Offshore Field – N/A= Not Available – S = Special Application – FS = Floating Storage – FSO = Floating Storage & Offloading * Nr of Fluid Swivel Circuit

Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
2009	428	India	Adani Port	HMPL	CALM	R	2x24"	1	320,000	32	Import Crude
2009	429	Nigeria	Usan	Total	CALM	E	2x20"	1	320,000	765	Deepwater buoy 1 x 24" floating line
2009	430	Libya	Al Khalij	GECOL	CALM	S	2x12"	2	50,000	24	Import heavy fuel oil
2009	431	Nigeria	Lagos	NNPC/Atlas Cove	CALM	R	2x24"	1	300,000	16.9	
2010	432	Indonesia	Ardjuna	Pertamina	CALM	E/FS	3x16"	2	138,000	42	Import and export crude oil / barge
2010	433	India	Hazira	Reliance	CALM	R	1x16" + 1x10"	2	100,000	25	Export of white product
2010	434	Iraq	Northern Gulf	South Oil CY of Iraq	CALM	EL	2x24"	1	350,000	28	Export of crude oil
2010	435	Iraq	Northern Gulf	South Oil CY of Iraq	CALM	EL	2x24"	1	350,000	30	Export of crude oil
2010	436	Iraq	Northern Gulf	South Oil CY of Iraq	CALM	EL	2x24"	1	350,000	30	Export of crude oil
2010	437	Iraq	Northern Gulf	South Oil CY of Iraq	CALM	EL	2x24"	1	350,000	N/A	Spare, standby buoy
2010	438	India	Paradip II	IOCL	CALM	R	2x24"	1	350000	32	
2010	439	India	Paradip III	IOCL	CALM	R	2x24"	1	350000	32	
2010	440	Tanzania	Dar Es Salaam	Tanzania Ports Authority	CALM	S	2x20"	2	100,000	25	
2010	441	India	Vadinar	Essar	CALM	R	2x24"	1	350,000	35	Replacement buoy
2011	442	India	Mangalore	EIL/Mangalore Refinery & Petrochemicals ltd	CALM	R	2x24"	1	320,000	33	
2011	443	India	Panna Field	British Gas India	CALM	E	1x8"	1	120,000	47	Crude Export with one permanent tanker
2011	444	Iraq	Northern Gulf	Leighton International	CALM	EL	2x24"	2	350,000	30	
2011	445	Iraq	Arabian Gulf	South Oil Cy of Iraq	CALM	EL	2x24"	1	350,000	30	
2012	446	Oman	Musandam	HYUNDAI for Oman Oil Company Exploration and Production (OOCEP)	CALM	EL	1x20"	1	320,000	40	
2012	447	Nigeria	Brass	NAOC	CALM	EL	2x24"	1	320,000	30	
2013	448	Indonesia	Poleng	Pertamina	CALM	FSO	2x24"	1	85,000	54.6	Replacement buoy
2014	449	Saudi Arabia	Al-Khafji	Saite / KJO	CALM	EL	1x24"	1	400,000	19.5	

The information provided in the above table has been given courtesy of SBM Offshore to show the SBM Offshore track record upon which Imodco Technology is built.

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Year	Nr.	Country	Location	Owner	System	*	Hose systems	*	Tanker size dwt	Water depth m	Particulars
2014	450	Malaysia	Melaka	Petronas Penapisan	CALM	R	2x24"	1	300,000	37	
2014	451	United Arab Emirates	Fathe Field, Dubai	Dubai Petroleum	CALM	EL	2x20"	1	350,000	47	
2014	452	Congo	Djeno	Total E&P Congo	CALM	EL	2x20"	1	350,000	23-35	
2015	453	New Zealand	Taharoa	New Zealand Steel	CALM	S	2x12"	1	186,000	34	Export of ironsand (slurry loaded)
2016	454	Egypt	El-Hamra	Wepco	CALM	EL	2x16"	1	150,000	26	
2016	455	South Africa	Durban	Sapref	CALM	R	2x24"	1	350,000	49	
2017	456	India	Mumbai	ONGC	CALM	E	1X12"	1	125,000	47.3	Relocation of a CALM on a new Terminal. 14 Mooring Buoys also supplied
2017	457	Brunei	Seria	Brunei Shell Petroleum	CALM	R	2X16"	1	175,000	23	Replacement of an existing Buoy
2017	458	Peru	La Pampilla Refinery	Repsol	CALM	R	2x16"	2	120,000	18.5	
2017	459	USA	St Croix	Limetree Bay Terminals	CALM	R	2X24"	1	320,000	207	Trelline (subsea line)

Imodco Terminals S.A
Imodco Services S.A

Head Office
5 route de Fribourg
CH-1723 Marly
Switzerland

Operations Office
11 avenue Albert II
Le Neptune 6
MC98000 – Monaco

Tel: +377 9205 1500
Fax: +377 9205 0480

contact@imodco.com

www.imodco.com

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The sole intention of this factsheet is to share general information.

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Building upon SBM Offshore Terminals Technology

5.2 Track Record

Summary of SOFEC Major CALM Buoy Projects

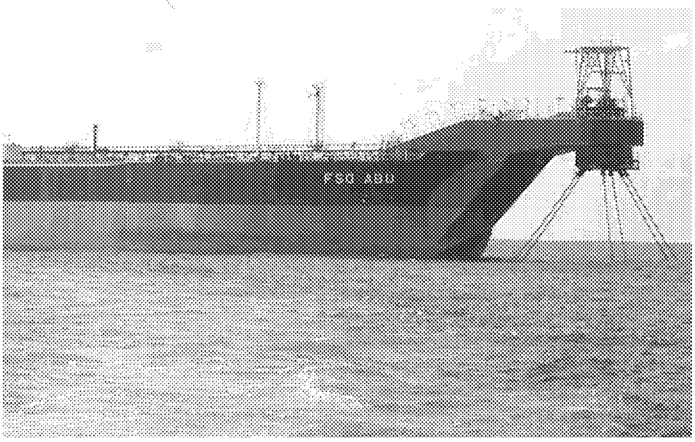
ent / Owner	Field Name	Vessel Name	Location	Contract Award Year	Water Depth	Dwt (000)	Hose/Riser	SOFEC System Type
DANGOTE OIL REFINING COMPANY (DORC)	Dangote Refinery	N/A	Nigeria	2016	23m-40m	2 each Crude Buoys-320 3 Multiproduct Buoys -160	2-24"	5 CALMs
Saudi Aramco	Jazan Economic City Red Sea Coast	N/A	Saudi Arabia	2014	25.5m	320	2-24in	2 CALMs
SEPOC	Ras Issa peninsula Red Sea	N/A	Republic of Yemen	2014	32.5m	300	2-20in	CALM
JGC	Nigh Son	N/A	Vietnam	2014	27m	300	2-24in	CALM
Pemex	Salina Cruz & Tuxpan	N/A	Mexico	2013	23m	60	N/A	2 CALMs
Pemex	Salina Cruz, Rosarito, & Tuxpan	N/A	Mexico	2012	23m	60	N/A	3 CALMs
TESORO Hawaii Corporation	Barber's Point	N/A	U.S.A.	2011	32m	320	2-16in & 1-20in	CALM
Shell	Malampaya	N/A	Philippines	2010	75m	110	N/A	CALM
Portman India Pvt Limited	Nagarjuna Refinery	N/A	India	2010	30m	300	2-24in	CALM
Oil Search Limited	Kumul Marine Terminal	N/A	Papua New Guinea	2010	35m	120	2-12in	CALM
NuStar Energy	St. Eustatius	N/A	Netherlands Antilles	2007	65m	520	2-24in 1-20in (Future)	CALM
IKPT / Pertamina	TTU Tuban Terminal	N/A	Indonesia	2007	23m 17m	35 150	3-16in 2-24in	2 CALMs
EIL /	Bina	N/A	India	2007	35m	320	2-24in	CALM

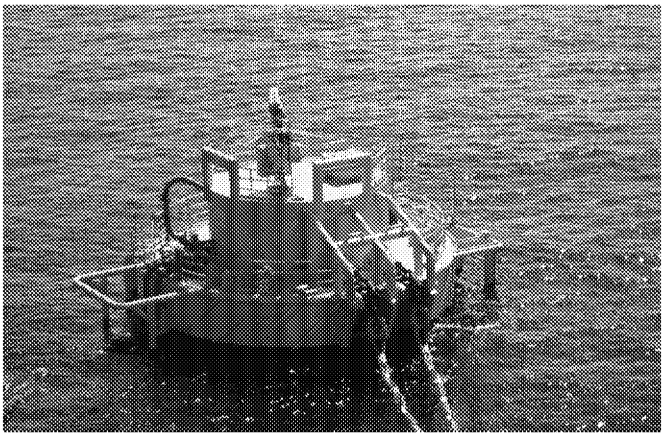
ent / Owner	Field Name	Vessel Name	Location	Contract Award Year	Water Depth	Dwt (000)	Hose/Riser	SOFEC System Type
BHARAT OMAN REFINERY	Refinery							
TERMAP S. A.	Caleta Olivia & Caleta Cordova	N/A	Argentina	2007	40m	160	2-20in	CALM
Butinge NAFTA	Butinge Terminal Spare Buoy	N/A	Lithuania	2006	20m	35-80	2-16in	CALM
HHI / KOC	Mina al Ahmadi #1 & #2 - Upgrade	N/A	Kuwait	2006	31m	456	2-24in	CALM
Sonatrach TRC	Arzew #1 & #2	N/A	Algeria	2002	62m 53m	320	2-24in	2 CALMs
Sonatrach TRC	Skikda #1 & #2	N/A	Algeria	2002	61m 81m	320	2-24in	2 CALMs
Sonatrach TRC	Bejaia	N/A	Algeria	2002	41m	320	2-24in	CALM
OCP / Techint	OCP CALM #2 Balao Terminal	N/A	Ecuador	2001	41m	250	2-24in	CALM
OCP / Techint	OCP CALM #1 Balao Terminal	N/A	Ecuador	2001	31m	130	2-24in	CALM
Shell	Malampaya	N/A	Philippines	1999	75m	40-110	2-12in 1-16in	CALM
ADCO	Jebel Dhanna #2	N/A	United Arab Emirates	1998	23m	450	2-20in	CALM
Petronas Carigali	Terengganu #2	N/A	Malaysia	1998	20m	85	2-20in	CALM
Cairn Energy India Pty Ltd	RAVVA	N/A	India	1998	25m	120	1-16in 1-20in	CALM
Petrozuata	Vehop	N/A	Venezuela	1997	25m	97	3-20in	CALM
Butinge Nafta	Butinge Terminal	N/A	Lithuania	1997	20m	35-80	2-16in	CALM
ADCO	Jebel Dhanna #1	N/A	United Arab	1995	21m	450	2-20in	CALM

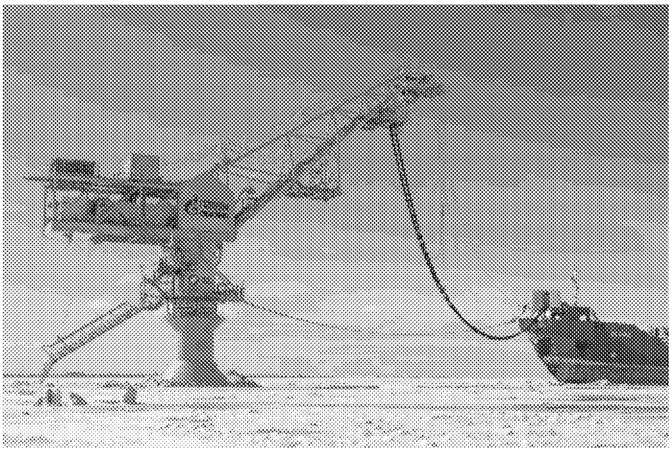
ent / Owner	Field Name	Vessel Name	Location	Contract Award Year	Water Depth	Dwt (000)	Hose/Riser	SOFEC System Type
			Emirates					
Kuwait Oil Co.	Mina al Ahmadi #1 & #2	N/A	Kuwait	1995	31m	456	2-24in	CALM
CFE	CFE #2 Tuxpan	N/A	Mexico	1994	16m	45	2-16in	CALM
CBI / Statia Terminals	St. Eustatious	N/A	Netherlands Antilles	1993	65m	520	2-24in 1-20in	CALM
ARCO	Pagerungan	N/A	Indonesia	1992	65m	120	1-12in	CALM
CPC	CPC Ta Lin Pu #4	N/A	Taiwan	1991	26m	100	2-20in	CALM
CPC	CPC Ta Lin Pu #3	N/A	Taiwan	1990	36m	300	2-24in	CALM
ADMA / OPCO	ADMA OPCO Das Island	N/A	United Arab Emirates	1990	28m	500	2-20in	CALM
ONGC	Hazira	N/A	India	1989	30m	50	1-16in	CALM
CFE	CFE #1 Tuxpan	N/A	Mexico	1988	16m	45	2-16in	CALM
HIRI	HIRI	N/A	Hawaii	1986	31m	150	2-16in	CALM
Shell	Palenque	N/A	Dominican Republic	1984	25m	100	2-16in	CALM
Petronas Carigali	Terengganu #1	N/A	Malaysia	1981	20m	85	2-20in 2-16in	CALM

ATTACHMENT 5 - BLUEWATER SPM QUALIFICATIONS

bluewater







Comprehensive Experience Overview

Oceans of knowledge

Floating Production, Storage & Offloading (FPSO) systems

YEAR OF INST.	FIELD OPERATOR	LOCATION/ FIELD Type of Mooring	WATER DEPTH (M)	TANKER NAME/ SIZE (DWT)	PRODUCTION FACILITIES (bopd + MMsfcd)
2018	HURRICANE ENERGY	LANCASTER FIELD	150	AOKA MIZU	
2013	ENQUEST BRITAIN Ltd.	UKCS/ALMA/GALIA FIELD Internal Turret	76	UISGE GORM 95.263	57.000 bopd
2011	ENI KITAN FIELD DEVELOPMENT	TIMOR LESTE	325	GLAS DOWR 89,562	40.000 bopd + 22 MMscfd (gaslift).
2010	CACT	HUIZHOU FIELD Dynamic Positioned	90	MUNIN	60.000 bopd
2009	NEXEN	NORTH SEA U.K., ETTRICK FIELD, UK Disconnectable Turret	115	AOKA MIZU 105,000	30,000 bopd 20 MMscfd
*) **2005**	EXXON MOBIL	CENTRAL NORTH SEA, NORWEGIAN SECTOR	126	JOTUN 92,000	70,000 bopd 68 MMscfd
) **2004	SHELL UK LTD	NORTH SEA U.K. ,PIERCE FIELD, UK Disconnectable Turret	85	HÆWENE BRIM 103,000	70,000 bopd 110 MMscfd
2004	CONOCOPHILLIPS	XIJIANG FIELD, CHINA Dynamic Positioned	100	MUNIN 103,000	60,000 bopd
) **2004	STATOIL/CNOOC	LUFENG Internal Turret (APL)	300	MUNIN 103,000	60,000 bopd
2003	PETRO SA	SOUTH AFRICA/ SABLE FIELD Internal Turret	102	GLAS DOWR 105,000	90,000 bopd 80 MMscfd
1999	TALISMAN	NORTH SEA U.K. / ROSS Internal Turret	100	BLEO HOLM 100,000	100,000 bopd 58 MMscfd

YEAR OF INST.	FIELD OPERATOR	LOCATION/ FIELD Type of Mooring	WATER DEPTH (M)	TANKER NAME/ SIZE (DWT)	PRODUCTION FACILITIES (bopd + MMsfcd)
1997	AMERADA HESS	NORTH SEA U.K. / DURWARD & DAUNTLESS Internal Turret	90	GLAS DOWR 105,000	60,000 bopd 85 MMscfd
1995	AMERADA HESS	NORTH SEA U.K. / FIFE Internal Turret	70	UISGE GORM 100,000	57,000 bopd 20 MMscfd
1990	OCCIDENTAL	CHINA / LUFENG CALM with Mooring Hawser	330	AYER BIRU 45,000	30,000 bopd
1989	MAXUS ENERGY	INDONESIA / INTAN Spread Mooring	42	LAN SHUI 70,000	60,000 bopd
1989	MARATHON PETROLEUM	AUSTRALIA / TALISMAN CALM with Mooring Hawser	80	ACQUA BLU 70,000	40,000 bopd
1988	AGIP	ANGOLA / SAFUEIRO Spread Mooring	40	ACQUA BLU 70,000	40,000 bopd
1987	AMOCO	CHINA / LIUHUA CALM with Mooring Hawser	± 300	LAN SHUI 70,000	60,000 bopd
1987	AMOCO	GABON / GOMBE MARIN Spread Mooring	20	ACQUA BLU 70,000	40,000 bopd
1985	MONTEDISON	ITALY / MILA CALM with Wishbone Yoke	50	ACQUA BLU 70,000	40,000 bopd

*) Acquired 55% ownership in Jotun FPSO

**) Purchased the Munin and Haewene Brim from Navion

Floating Storage & Offloading (FSO) systems

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD Type of Mooring	WATER DEPTH (M)	TANKER NAME / SIZE (DWT)
1993	TOTAL EXPLORATION & PRODUCTION	THAILAND / BONGKOT Internal Turret	80	LAN SHUI 26,000
1989	SOVEREIGN OIL & GAS PLC	UNITED KINGDOM / EMERALD Tripod Wishbone	150	AILSA CRAIG 200,000
1986	OCCIDENTAL / ECOPETROL	COLOMBIA / COVENAS CALM Wishbone	35	FSO COVENAS 390,000
1982	PHILLIPS PETROLEUM	IVORY COAST / ESPOIR CALRAM	87	TT PHILLIPS 230,000

Internal Turrets

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2017	TOTAL	KAOMBO (BLOCK 32), ANGOLA	1700	VLCC
2017	TOTAL	KAOMBO (BLOCK 32), ANGOLA	1700	VLCC
2006/2007	BP NORGE	SKARV (FEED CONTRACT)	370	200,000
2003	PETROSA	SABLE FIELD, SOUTH AFRICA	100	(GLAS DOWR) 105,000
1999	PETROBRAS	BRAZIL / MARLIM (FSO P38)	1,020	270,000
1999	AMERADA HESS / SHELL	UNITED KINGDOM / TRITON	92	105,000

1999	PETROBRAS	BRAZIL / RONCADOR (FSO P47)	815	280,000
1999	ESSO	CENTRAL NORTH SEA, NORWEGIAN SECTOR / JOTUN	126	92,000
1998	TALISMAN	NORTH SEA U.K. / ROSS	100	(BLEO HOLM) 100,000
1998	PETROBRAS	BRAZIL / MARLIM (FPSO P37)	900	269,000
1998	PETROBRAS	BRAZIL / MARLIM	163	282,750
1997	AMERADA HESS	NORTH SEA U.K. / DURWARD & DAUNTLESS	90	(GLAS DOWR) 105,000
1996	CONOCO	NORTH SEA U.K. / MCCULLOCH	150	100,000
1995	AMERADA HESS	NORTH SEA U.K. / FIFE	70	(UISGE GORM) 100,000
1993	TOTAL EXPLORATION & PRODUCTION	THAILAND / BONGKOT	80	LAN SHUI 26,000

Disconnectable Turrets

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2009	NEXEN	NORTH SEA U.K., ETTRICK FIELD, UKCS	115	(AOKA MIZU) 105,000

External Turret Mooring systems

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2013/2014	EXXONMOBIL (MWCS Company)	GULF OF MEXICO	150-1500	AFRAMAX
2011	STX Heavy Industries Co. Ltd	Korea	45	FSU 341,000
2009	TALISMAN / MISC	BUNGA ORKID FIELD	55	"MT FSO ORKID" 100,047
2006	PETRONAS / MISC	ABU CLUSTER FIELD	61	"MT ARMATA" AFRAMAX 89,920

Calm Buoy systems (Turret Buoys)

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2018	PERTAMINA	JAKARTA	18	10,000 – 50,000
2018	PERTAMINA	SEMARANG	18	10,000 – 50,000
2018	PERTAMINA	BELAWAN	18	10,000 – 50,000
2015	ADMA – OPCO	SATAZ AL-RAZBOOT (SARB), ZIRKU ISLAND	28	320,000
2014	PETROBRAS	TEFRAN	25	80,000-120,000

2014	PETROBRAS	TEFRAN	25	80,000-120,000
2014	PETROBRAS	TEFRAN	25	80,000-120,000
2013	PDVSA	TAECJAA Terminal, Venezuela	25	300,000
2013	PDVSA	TAECJAA Terminal, Venezuela	28	300,000
2013	PETROBRAS	Brazil, Campos Basin	70	350,000
2013	PETROBRAS	Brazil, Campos Basin	70	350,000
2012	FAPCO	Fujairah, UAE	40	50,000 – 150,000
2012	PDVSA	VENEZUELA	16	80,000
2012	CPC	Russia, Novorossiysk	58	15,000 - 300,000
2011	CAIRN ENERGY	INDIA	28	120,000
2010	ECOPETROL	COLUMBIA	25	350,000
2010	ECOPETROL	COLUMBIA	35	350,000
2010	HPCL-INDIA	VISAKHAPATNAM-INDIA	35	320,000
2010	ADCOP - ABU DHABI, UAE	FUJAIRAH, UAE	35	320,000
2010	ADCOP - ABU DHABI, UAE	FUJAIRAH, UAE	52	320,000
2010	ADCOP - ABU DHABI, UAE	FUJAIRAH, UAE	54	320,000
2009	PETRONAS CARIGALI (TURKMENISTAN) SDN	KIYANLI (KASPIAN SEA, TURKMENISTAN)	17	12,000

2009	BRUNEI ECONOMIC DEVELOPMENT BOARD (BEDB)	MUKIM LIANG, BRUNEI	25	46,000
2009	ROMPETROL	BLACK SEA	25	165,000
2009	ENI	BLACKTIP, AUSTRALIA	27	350,000
2009	MAERSK OIL QATAR	BLOCK 5, QATAR	60-63	500,000
2009	MAERSK OIL QATAR	BLOCK 5, QATAR	60-63	500,000
2009	MAERSK OIL QATAR	BLOCK 5, QATAR	60-63	500,000
2008	BP TRINIDAD AND TOBAGO	GALEOTA TERMINAL, TRINIDAD	29	150,000
2008	AL-KHAFJI JOINT OPERATIONS (KJO)	AL-KHAFJI Terminal, Saudi Arabia	23	300,000
2007	QATAR GAS	RAS LAFFAN TERMINAL	37	320,000
2007	QATAR GAS	RAS LAFFAN TERMINAL	37	320,000
2007	THAI OIL, THAILAND	SRI-RACHA TERMINAL	30	220,000
2007	KOCHI REFINERIES LIMITED	OFFSHORE COCHIN	30	300,000
2006	ABU DHABI OIL CO. LTD, JAPAN (ADOC)	MUBARRAZ OIL FIELD	19	330,000
2005	TPPI INDONESIA	TUBAN AROMATIC PLANT, INDONESIA	50	185,000
2005	PEREMBA CONSTRUCTION	MELUT BASIN OIL DEVELOPMENT PROJECT, SUDAN	55	300,000

2005	ADMA-OPCO	DAS ISLAND, UAE	26	360,000
2004	OXXO SA	LA LIBERTAD REFINERY, EQUADOR	15	45,000
2004	SADRA GROUP	ASSALUYEH, IRAN	45	250,000
2004	BHP BILLION	ANGOSTURA, TRINIDAD	25	150,000
2004	AGIP GAS B.V.	WEST LIBYA/WAFA	26	30,000 - 80,000
2002	AMERADA HESS	EQUATORIAL GUINEA / CEIBA	67	350,000
2002	VOPAK ENOC FUJAIRAH LTD.	UNITED ARAB EMIRATES / FUJAIRAH	25	175,000
2001	UNOCAL	THAILAND / BIG OIL FIELD	74	120,000
2000	WOODSIDE ENERGY LTD.	AUSTRALIA / LEGENDRE	49	90,000 - 120,000
1999	GREATER NILE PETROLEUM OPERATING COMPANY	SUDAN / MUGLAD BASIN DEVELOPMENT	54	40,000 – 300,000
1998	GEORGIAN PIPELINE COMPANY	GEORGIA / CHIRAK	50	60,000 – 150,000
1998	ENRON	INDIA / DABHOL POWER PLANT	19	60,000
1997	APACHE ENERGY	AUSTRALIA / STAG	46	150,000
1997	VOLTA RIVER AUTHORITY	GHANA / TAKORADI	30	40,000
1996	FRED. OLSEN / SOEKOR	SOUTH AFRICA / SOEKOR E-BT	118	128,000
1996	OLEODUCTO / CENTRAL S.A.	COLOMBIA / COVENAS	28.8	50,000 – 160,000

1995	UNOCAL	THAILAND / ERAWAN	67	150,000
1993	TEXACO	ANGOLA / BLOCK 2	35	175,000
1993	CORPOVEN (PDVSA)	VENEZUELA / JOSE ORIMULSION	28	45,000 – 250,000
1992	CHEVRON NIUGINI	PAPUA NEW GUINEA / KUTUBU	27	300,000
1989	MARATHON PETROLEUM	AUSTRALIA / TALISMAN	80	70,000
1986	OCCIDENTAL COLOMBIA	COLOMBIA / COVENAS	25	60,000 - 120,000
1985	KODECO / PERTAMINA	INDONESIA / MADURA	28	120,000
1984	MOBIL	INDONESIA / ARUN	59	40,000 - 280,000
1983	ELF GABON	GABON / MAYUMBA	30	30,000 - 100,000
1980	ELF SEREPCA / SHELL OIL	CAMEROON / KOLE – RIO DE REY	30	250,000
1980	ELF GABON / GULF OIL	GABON / MAYUMBA	30	70,000

Calm Buoy systems (Deepwater)

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2014	TOTAL E&P ANGOLA	CRAVO, LIRIO, ORQUIDEA and VIOLETA (CLOV) oil fields located offshore in Angola (Block 17)	1260	140,000 - 350,000

Calm Buoy systems (Turntable Buoys)

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2008	KUWAIT OIL COMPANY (KOC)	KUWAIT OIL COMPANY (KOC) TERMINAL	25-30	300,000
2008	KUWAIT OIL COMPANY (KOC)	KUWAIT OIL COMPANY (KOC) TERMINAL	25-30	300,000
2005	SHELL NIGERIA	BONNY TERMINAL, NIGERIA	36	350,000
2003	ZUEITINA OIL COMPANY	LIBYA/MARSA AL BREGA	32	275.000
2002	TOTAL FINA ELF E&P CONGO	CONGO / DJENO	35	340,000
1996	BRUNEI SHELL PETROLEUM	BRUNEI	25	20,000 - 350,000
1995	SHELL SARAWAK BERHAD	MALAYSIA / MLNG-2 PLANT	20	100,000 - 350,000
1993	ONGC	INDIA / NEELAM	57	147,000
1991	SHELL EASTERN PETROLEUM	SINGAPORE / PULAU BUKOM	35	150,000 - 350,000
1988	SHELL	GABON / GAMBA	23	50,000 - 150,000
1986	SHELL	NIGERIA / BONNY	28	35,000 - 350,000

CALM Buoy Wishbone systems for Permanent Mooring

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
1986	OCCIDENTAL / ECOPETROL	COLOMBIA / COVENAS	35	390,000
1985	MONTEDISON	ITALY / MILA	50	70,000
1983	AMOCO	GABON / INGUESSI	30	230,000
1982	PHILIPPINES CITIES SERVICE	PHILIPPINES / NIDO	73	55,000

CALRAM Buoy systems for Permanent Mooring

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
1995	HAMILTON OIL	LIVERPOOL BAY / DOUGLAS	30	116,500
1982	PHILLIPS PETROLEUM	IVORY COAST / ESPOIR	87	240,000
1981	UNION OIL OF THAILAND	SOUTH CHINA SEA / ERAWAN	68	85,000

Conventional Buoy Mooring (CBM) systems

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2012	ONGC	Mumbai High	75	2,500
2004	CPTP, S.A.	CANICAL LPG TERMINAL, MADEIRA	20	30,000
2002	SHUWEIHAT POWER COMPANY	SHUWEIIHAT/JEBEL DHANA, UAE	10	5,000
1999	SHELL TERMINAL LANKA	SRI LANKA / COLOMBO	15	20,000
1994	ONGC	INDIA / BOMBAY HIGH	74	2,500
1989	ONGC	INDIA / BOMBAY HIGH	68	2,500
1987/1988	ONGC	INDIA / BOMBAY HIGH SOUTH	60	2,500

Tower Mooring systems

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2015	GAZPROM NEFT	OB-TAZ river mouth, NOVIY PORT, RUSSIA	10,4	55,000
2008	LUKOIL	RUSSIA, CASPIAN SEA YURI KORCHAGIN FIELD	22	30,000
2009	CONOCOPHILLIPS	PENGLAI FIELD, BOHAI BAY, CHINA	27	300,000
2005	EXXON NEFTEGAS LIMITED	SAKHALIN ISLAND	45	110,000

1996	TEXACO / ANGOLA	LOMBO FIELD, OFFSHORE ANGOLA	37,5	270,000
YEAR OF INST.	**FIELD OPERATOR**	**LOCATION / FIELD**	**WATER DEPTH (M)**	**TANKER RANGE (DWT)**
1985	SOVEREIGN OIL & GAS, DAVY OFFSHORE / NORTH SEA	EMERALD FIELD, NORTHERN NORTH SEA	150	200,000
1982	HUDBAY OIL / MALACCA STRAIT, MALAYSIA	SUMATRA, INDONESIA	23	140,000

Swivel Stacks

YEAR OF INST.	FIELD OPERATOR	LOCATION / FIELD	WATER DEPTH (M)	TANKER RANGE (DWT)
2010	EMAS OFFSHORE CONSTRUCTION AND PRODUCTION PTE LTD (EOCP)	BLOCK 12W IN VIETNAM	95.6	185,000
2010	SAIPEM S.P.A.	AQUILA FIELD	815	112,000
2010	SAIPEM S.P.A.	LIVORNO FIELD	112	80,000